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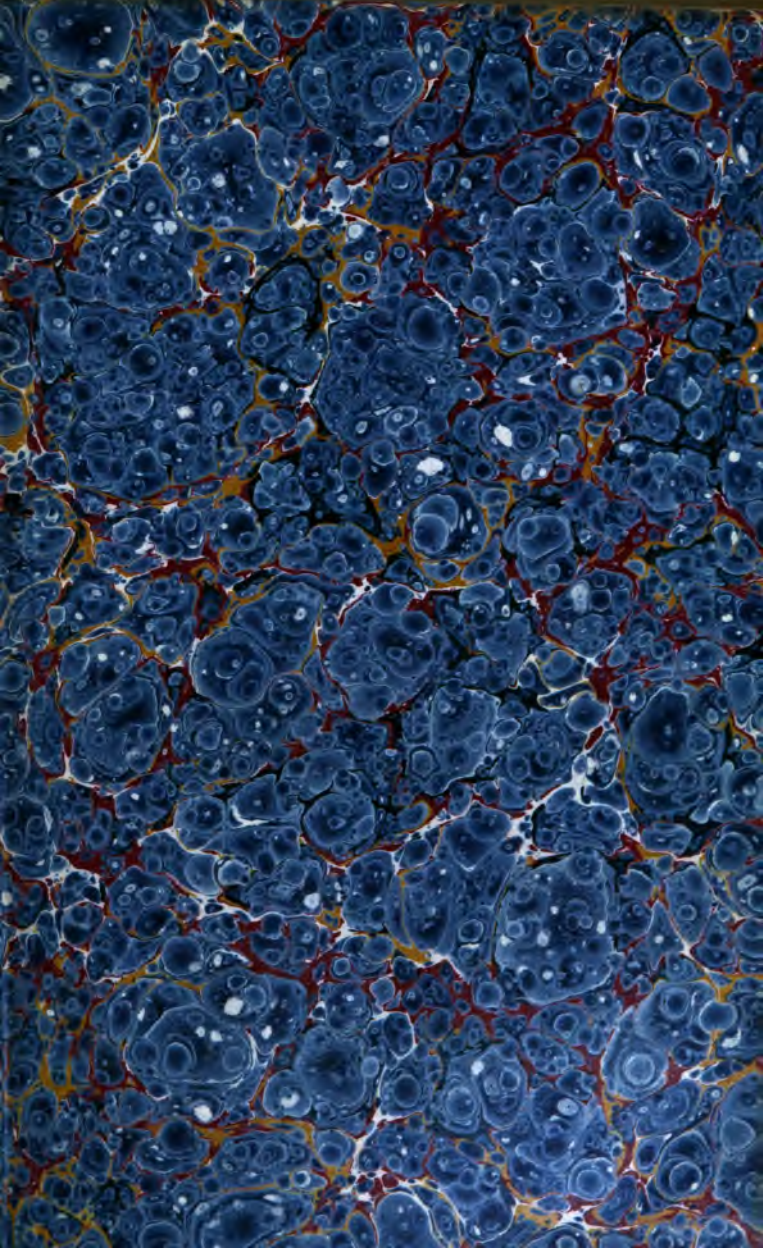

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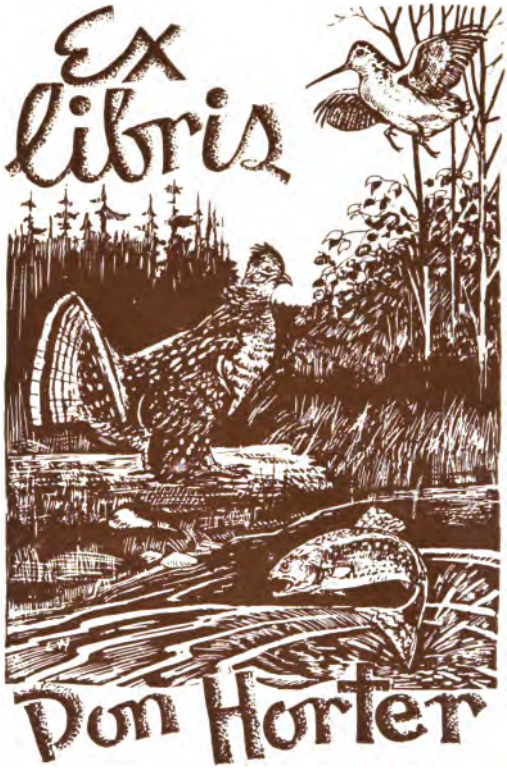

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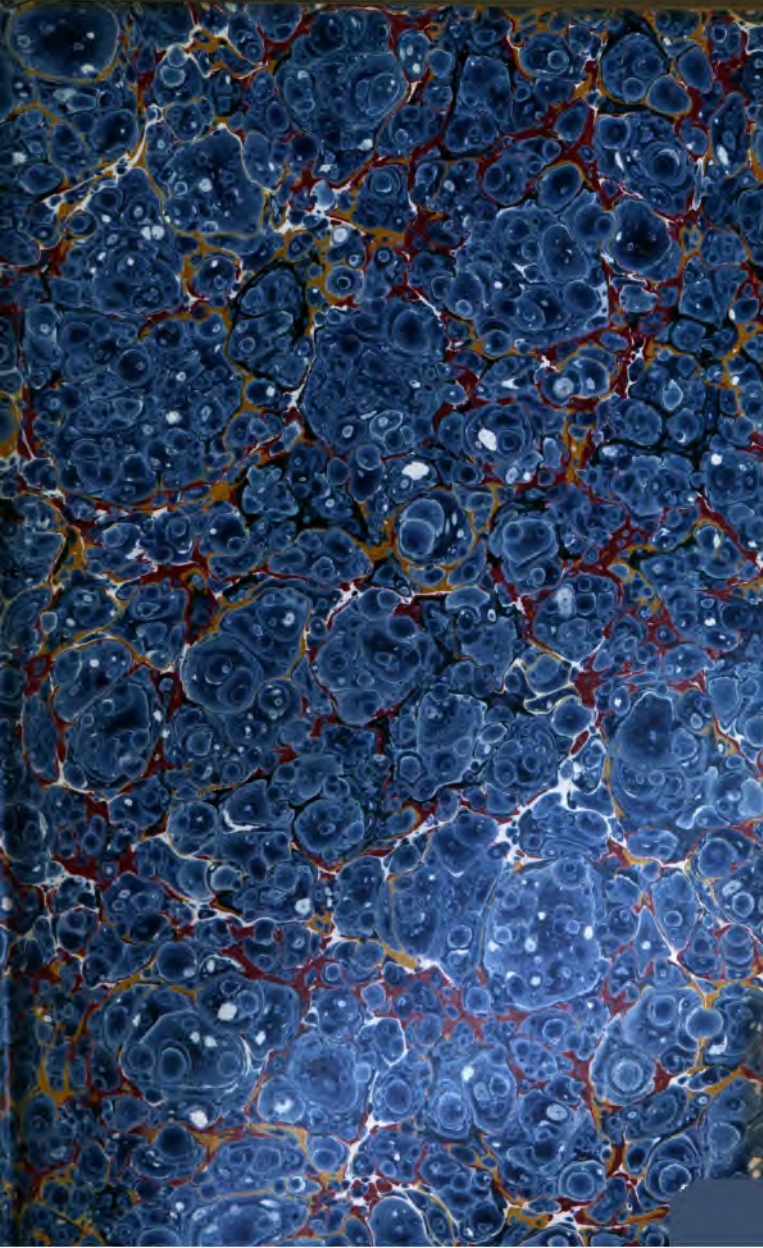

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THE

NATURAL HISTORY AND HABITS

OF

THE SALMON;

WITH

REASONS FOR THE DECLINE OF THE FISHERIES,

AND

ALSO HOW THEY CAN BE IMPROVED,

AND AGAIN MADE PRODUCTIVE:

ALSO

AN ACCOUNT OF THE ARTIFICIAL INCUBATION OF THE SALMON.

BY ANDREW YOUNG,

INVERSHIN, SUTHERLANDSHIRE.

LONDON:

LONGMAN, BROWN, GREEN, AND LONGMANS.

1854.

" He took the basket on his back,
The rod into his hand,
And by a pleasant river side,
He there took up his stand."

Scottish Angler.

LONDON:
A. and G. A. SPOTTISWOODE,
New-street-Square.

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THE

FOLLOWING PAGES ON THE HABITS OF THE SALMON

ARE, BY PERMISSION,

VERY GRATEFULLY INSCRIBED,

TO

THE MOST NOBLE

THE MARQUESS OF STAFFORD,

BY

HIS MOST OBEDIENT SERVANT,

THE AUTHOR.

M844841

PREFACE.

In endeavouring to give a short, and, I hope, correct, account of the habits and migrations of the salmon in rivers, and while absent from these rivers, I have confined the account generally to the natural habits of working and depositing their seed; how instinct leads them, at the proper time, to select the suitable places in a river wherein they may deposit their seed to advantage, and where, unless by some natural yet unforeseen cause, it will lie in security until the time of incubation is over, when, after that, their security entirely depends on the dictates of nature and the wide waters for their feeding-ground.

I have touched very little on artificial breeding, that being a process perfectly simple; for if a breeding-box be made, resembling the natural beds made by the fish themselves in a river, and a constant run of water over the box, so as to keep the eggs from becoming addled, and the ova be properly

selected and impregnated and placed in such box, nature solely does the rest. But after incubation is over, the difficulties to be encountered by the artificial breeder have just only begun: everything previous to that is perfectly simple and easily gone about.

I accounted for the degenerate state of salmon rivers now to what they were formerly by pointing out the great care and protection they enjoyed in days of yore, and the inattention and carelessness exercised over them by all parties now; how they have been left entirely at the mercy of the robber and plunderer; how the breeding fish are killed and massacred by poachers; and how they are caught at unreasonable times by various fixtures and devices, under the sanction of law; and also that the present existing fishery law is not at all adapted to the circumstances and habits of the salmon, but quite the contrary, and that, under the influence of that law, no river whatever can prosper, but all must retrograde, as has been evidently seen for the last twenty-five years. The Legislature has been often appealed to, so as to get the law made suitable to the habits of the fish; but all appeals have hitherto proved fruitless. And for some of the reasons why the present state of matters is allowed to remain, we

refer to a letter in the Appendix, from Mr. Wallace, late M.P. for Greenock, in which he states the reasons of the decline of the salmon, the injustice of the existing law, and the attempts he made when in Parliament to get that law altered, and the selfish ends that operated against the alteration.

I explained how the salmon paired in autumn, and the way they went on with the work of spawning; that they first dig a hole in among the sand and gravel, by the male and female working alternately and forcing the stones aside with their snouts, and when the hole is deep enough to receive part of the spawn, the female emits a portion of the ova (all the part that is fully ripe at the time), and when that is done the male approaches the trench, and by emersion of the ripe quantity of milt impregnates the eggs that had been laid. When that is done, they begin again to dig up against the stream, for the twofold purpose of covering the laid ova, and also for making another bed for the next quantity to be deposited. Thus they continue digging, depositing, and covering alternately, until the whole ova and milt of the pair is laid down and securely covered. Also, a full account of beds' making and spawning process will be found in the Ap-

pendix, extracted from Ephemera's "Homilies and Lectures on Salmon and Rivers;" and as Ephemera is a gentleman who has long studied, travelled by the river sides, and examined both salmon fry and spawn, his views on all their habits will be found perfectly correct. He is none of those theorists who, by taking wide departures from nature, land an audience in mist and themselves in an absurdity. He has studied nature, and has given it the very same as he has found it.

I have described the ova in the various stages throughout incubation, the progress it made from time to time, and the appearance the young fish had, and how they lie in the egg, the appearance and size they have at hatching-time, and also the changes and sizes of the fry from the egg to the smolt—that is, when a coating of small silver-looking scales covers all their dark-looking sides and bars that distinguished them from the age of two months until now. Also, that, at this age and change, the young salmon, no longer known by the name of salmon fry, are now known as smolts, they being now twelve months old, and at the age and time that nature tells them they have to emigrate to some other locality; therefore they gather together in bands, and leave the water in

which they have been hatched and remained in, quite contented, for a whole year. They proceed downward with the same sagacity as if they had gone the road before, and at last arrive at an entire change of water, and where food is so plentiful that they can eat as fast as their rapacious stomachs can digest; and by that means, in a couple of months after enjoying these fine pastures, they have grown so large and fat that necessity compels them to return to their poor highland rivers again.

But a vicious law, said to be for the protection of salmon fisheries, has allowed the road by which they return to be barricaded with wood and network; so that they find returning impossible. To be sure, they saw these apparatuses when they were going down the rivers; but at that time they were so small that, with the exception of an occasional cartload of them that happened to fall into pools about the stake net, and were left high and dry or eaten by gulls and other waterfowl, they went easily through the meshes of the net. But when they returned it was quite a different thing, for now they had grown to such a size that they found their progress fairly arrested; and when searching for a passage of any kind by which they might pass, at last they find a small passage a few

inches wide, but still wide enough for the entrance of a salmon: in they go here, dozen after dozen, but, to their utter astonishment, they are now in a tank surrounded on all sides with close network; and as the door they entered by was wide without and narrow within, and copious room in the confinement, no door of retreat could be found, therefore, there they must remain until the tide recedes, when they are relieved by the hoop net and murderous knabby of the marauder. This is a specimen of how salmon are allowed to return to their rivers; and, with such laws, where is the encouragement for those who breed and watch over them in those early years to do so? *This is what I would call injustice to Scotland.* An English Parliament has long ago ruined their own rivers, and it looks but too like that they want to deprive poor Scotland of her salmon also.

The few fish that escape these ugly snares (I must say snares, for they are many, or rather one continuation, with but little interval, from the top to the bottom of the first, and from one lock on the coast to another), the few fish that do escape, find their way through all that multitude of difficulties to the rivers where they were bred: but, from the late period at which the fishings close, a goodly portion of even those who are fortunate

enough to reach the rivers, fall a prey to the net, rod, or poacher's spear; so that, by the time for the operations of spawning, the ranks are awfully thinned, and the numbers of breeding fish are but few.

And even during the spawning time their destruction does not cease; for then the torch and spear make sad havoc. I have inserted in the Appendix some remarks from Mr. Tod Studdart on that head, and may mention that he is a gentleman who has paid the greatest attention to the habits of salmon, and has often remonstrated against the bad laws and the wholesale destruction of the breeding fish. I have seen too much of that conduct, both with the sanction of the law and without it, to doubt one word in that statement; I would much rather be inclined to say that the one half of the depredations and destruction has not been told. However, there has been exposed such a statement of facts, showing the neglected state of salmon fisheries, that I hope it will awaken the Legislature to a sense of the necessity for an immediate alteration of laws so hurtful to the prosperity and production of such a material part of the food of the country.

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THE

NATURAL HISTORY AND HABITS

OF

THE SALMON.

From the earliest records we find Salmon Rivers and Salmon Fisheries held in great estimation both by the Crown and the population; for in these early times the rivers produced not an inconsiderable portion of the food of the people: this was perfectly known to the rulers of the land; they saw that it was such a material part of the actual support of the nation, that the Crown took these fisheries under its own protection and care; and in those days it was a very particular favourite indeed, and one who was expected to act with care towards a salmon river, that got a grant or right to fish that river under the Crown, and for the general good of the country adjacent to such; it was never expected by the grantor, that these rights were either to be destroyed or neglected. And we find a very stringent Act passed in the reign of King Robert the First, in 1318, expressly forbidding, under severe penalties, the erection of fixtures of any size or dimensions whereby the fish may be destroyed, or their progress up and down the river prevented. And

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James the First, in 1424, we find it ordained, "That all cruives and yairs set in fresh water where the sea fills and ebbs, and which destroy the fry of all fishes, be destroyed and put away for three years to come, notwithstanding any privileges or freedom given to the contrary, under the payne of 10*l.*" And in 1427, the Act for destroying cruives is continued for after three years. And in 1429, the same Act is to be in force until revoked by the King and Parliament.

How very different these regulations were from the conduct of our Government now-a-days; for now the waters where the sea flows and ebbs are completely shut up with stake-nets, bag-nets, yairs, and every imaginable device and invention that the ingenuity of man can contrive for the destruction and extinction of the salmon race, and yet we have not had one of all our legislators who has come boldly forward to rescue the fast disappearing and perishing fisheries from the grasp of their destroyers.

We again find an Act in the reign of King James the Second, in the year 1457:—"Item, That nae man in smolt time sett vessels, creels, weirs, or any other engines to prevent the smolts passing to sea, under the paine of ten pounds to the king, and the sheriffs are required to destroy all that are made."

And in James the Third, in 1477, it was enacted and ordained,—"That the Acts made by King James the First, anent cruives sett in waters, be observed and kept, the which bears in effect, that all cruives sett in waters where the sea fills and ebbs, and which destroys the fry of all fishes, be put away and *destroyed for evermore*, notwithstanding all freedom or privileges given to the contrairy, under the penalty of five pounds for each cruive; and they that have cruives in fresh water, that they gar keep the laws anent the Saturday slap, and suffer them not

to stand in forbidden time, under the same paine; and the hecks of said cruives be three inches apart, the same as the Act made by King David."

We have here laws made that clearly show the wisdom of our forefathers; for although they were ignorant of many of the habits of the young fish,—such as the length of time required for hatching, the time the fry remain in the rivers before their first departure to the sea, and the time between the smolts going down and their returning grilses, —yet for all that, they knew perfectly that salmon required to get to the rivers for the purpose of spawning, that the fry was bred in rivers, and that they needed free access to the sea, and they provided accordingly. We see a provision made against killing the smolts in the smolt season, but their ideas of that time were more imperfect than it is now; for they thought that the smlots all left the rivers with the first floods in May. However, now, with far more extended knowledge of their habits, we have no such provision; at all events, the law we have against smolt killing is never put in force. In these days, the lieutenants, sheriffs, and, in short, all government officials, were instructed to see all Acts of the Legislature put in force; but now we may go from river to river, and from stream to stream, over the length and breadth of this kingdom, and see multitudes of men and boys who make it their regular employment day after day to kill them in thousands, and that with impunity and undisturbed, unless some poor tenant of fishings may ineffectually try to drive them away, which he finds a mere impossibility. We also see here, that fixtures in waters where the tide flows and ebbs are ordered to be removed, and *destroyed for evermore.* How unlike the present time; for now the waters where the sea flows and ebbs are complete wicker-works, nothing to be seen

but stakes and nets, the one after the other, until the whole rivers and firths look more like forests than any thing else; and the event is, that very few fish can get up to breed, and that few, after spawning, can ever get down again, and the result is, that there is little now to catch but grilses, and these a very scanty crop, getting fewer and fewer every year.

We again see that an Act of King James the Fourth, in the year 1489, is particular towards the government officials doing their duty. "Chap. 16th." Item: Anent cruives and fish yairs which destroy the fry of fish, and hurt the common profit of the realm, it is statute and ordained, that the Acts and Statutes made before be observed and keept, with this addition: That letters be written to all sheriffs, baillies, and stewards, to *destroy, cast down, and put away* all such cruives within their bounds incontinent without delay. And that dittay be tane of them, that has cruives in contrary to said Act, and to be paid for each cruive five pound, to be raised on the master and upholder of the same. And in likewise, that the *sherrifs* that destroys not the said cruives within forty days of this Parliament, the said sheriff to be amerced in forty pounds to the King. And for millers that setts creels and nets in dams and lades of water, destroying red fish, and fry of fish as said is it shall be a point of dittay; and the pain both of the cruives, creels, netts of millers, ilk ane of them to be as an outlaw of red fish."

An Act of King James the Fifth, in the year 1535, says: "Our *severen* lord ordains the Acts made upon them that slays red fish, smolts, and salmon in forbidden time, and the pains contained in the same to be put in sharp execution."

An Act of Queen Mary in the year 1583, repeats the former Acts and ratifies them, with this addition:

"That is to say, that all cruives and yairs that are *set of late* upon sands and schoals far within the water where they were not before, that they be uncontinued, taen down, and put away. And the remaining cruives that are sett and put up on the water sands, to stand till the first day of October, nixt to come, and uncontinued after the said first day, to be destroyed and put away for ever. And for the execution of this Act, ordains every earl, lord, barron, and gentleman landed, within his own bounds, to cause remove, destroy, put down, and take away the said cruives and yairs, in manner foresaid, under the paine of one hundred pounds to be taken up of their goods, that puts not this Act in due execution."

Yet, notwithstanding all the former Acts for the preservation of the salmon and salmon fry, we find an Act of King James the Sixth, in the year 1581, which, after ratifying all the previous Acts, with the consent and advice of the three estates of Parliament, ordains and appoints the following, as justices or conservators over the rivers in Scotland: "Viz., George, Earl of Caithness, for the bounds of *Caithness* and *Strathnaver*;* Alexander, Earl of Sutherland,

* This Alexander, Earl of Sutherland, was the 16th earl from a direct line of ancestors; and during the lifetime of Earl John, the 17th, Earl John, the 18th, Earl George, the 19th, Earl John, the 20th, and Earl William, the 21st earl in a direct line, the conservation of rivers was not neglected. William, the 22nd earl, was the father of the late and respected duchess, Countess of Sutherland; and I have no hesitation in saying, that while she lived, she took the greatest interest in the protection and improvement of the salmon rivers in Sutherland; and the present duke, her successor, has done, and is continuing to do, exactly what the Government of Queen Mary requested of Earl Alexander, in the year 1583. The present duke prohibits all stake-nets, bag-nets, and ruinous fixtures, on all parts of his extensive coasts and estuaries. But the benefit derived from that

for the bounds of *Sutherland* and all the *rivers therein.* The said Earl of Sutherland, George Ross, of Balnagower, and Robert Munro, of Fowles, conjunctly and severally, for the water of the *Killosochell* (that part is now known as the Kyle of Oykel, and contains the water from Castle-na-Care, in Strath-Oykel, down to the bar at the Gizzen Briggsbelow, the royal burgh of Tain). The said Robert Munro, of Fowles, baillie and chamberlain of Ross, for the water of *Conan;* James, Earl of Arran, and his deputies, for the water of *Ferrar;* the sheriff of Inverness and his deputies, and the provist and baillies of Inverness, for the water of *Ness;* the sheriff of Nairn and his deputies, and the provist and baillies of Nairn, for the water of *Nairn;* the sheriff of Elgin and Forress, and his deputies, and the baillies of the earldom of Murray and of the Abey of Kinloss and Priory of Plusseardine, and the provist and baillies of Elgin and Foress, for the waters of *Spey, Findhorn,* and *Lossey;* the sheriff of Banff and his deputies, and the provist and baillies of the Burgh of Banff, for the water of *Devern;* the Laird of Essilmount, for the water of *Ythane;* the Earl of Marchell, for the water *Ugg;* the sheriff of Aberdeen and his deputies, and the provist and baillies of Aberdeen, for the waters

prohibition is not to the extent that it would be, if neighbouring proprietors of fishings would follow his example; for many of the fish bred and reared on the Sutherland rivers are captured by others on the way to and from the sea, whereby the real profit to be derived from a just, faithful, and expensive conservation is greatly diminished. However, his Grace has the satisfaction to know, that throughout the extensive county of Sutherland, there is not one fishless river, nor one river but what is worth less or more rent; whereas more than half the other rivers mentioned in the Act of 1583, are fishless, and the remainder of them almost worthless.

of *Dee* and *Don;* the sheriff of Kincardine and his deputies, for the waters of *Cowy* and *Berwy;* the Earl of Montrose and the provist and baillies of Montrose, for the waters of *North* and *South Esk;* the Sheriffs of Perth and Forfar, stewart of Strathearn and their deputies, and provists and baillies of Perth and Dundee, for the waters of *Tay* and *Erne,* and their *graines* (tributaries); the sheriff of Fife and his deputies, for the south side of the *Tay,* lying within the sherifdome of Fife, and the water of *Levin;* the provist and baillies of Coupar, for the water of *Eden;* the steward of Monteath and his deputies, for the heads of the waters of *Teith* and *Forth;* and the sheriff of Stirling and his deputies, and the provost and baillies of Stirling, for the remnant of the waters of *Teith, Forth, Guidie, Carron, Alloua,* and *Dovane,* and their *graines;* the sheriff of Linlithgow and his deputies, and the provist and baillies of Linlithgow, for the water of *Avone,* and the south side of the *Forth,* within the bounds of the sherifdome; the sheriff of Edinburgh and his deputies, and the provost and baillies of Edinburgh, for the waters of *Ammond, Leith, North* and *South Esk;* the sheriff of Edinburgh within the constablrie of Haddington, for the waters of *Tyne* and *Beil;* the sheriff of Dumfries and his deputies, the Earl of Mortoun, wardane of the West Marshes, and his deputies, and the provost and baillies of Dumfries, Kirkcudbright, and Aunaud for the *Aunaud, Nyth, Dee, Crel,* and *Luce.* The baillie of Carricht and his deputies, for the waters of *Stinchell* and *Girvane.* The sheriff of Air and his deputies, and the provost and baillies of Air, for the waters of *Dune* and *Air;* the baillie of Cunningham and his deputies, and the provost and baillies of Irving, for the waters of *Irving* and *Garnock;* the sheriffs of

Lanark, Renfrew, and their deputies, and the provost and baillies of Glasgow, Renfrew, and Lanark, for the waters of *Clyde* and *tributaries* thereof; the sheriff of Dumbartone and his deputies, and baillies of the burgh of Dumbartone, for the waters of *Levin* and *Amrik;* the sheriff of Argyle and Tarbet, and his deputies, for the bounds of the said sherifdome and lorne, to the march of the sherifdome of Inverness; and the said sheriff of Inverness and his deputies, for all the bounds of the said sherifdome on the *north-west coast, from the march of the sherifdome of Argyle to Strathnaver.* Given, granted, and committed to the said justices in that part conjunctly and severally, within the bounds particularly above written, full power, special command, express bidding and charge, to take up all persons, contraveners of said Acts of Parliaments, the principal offenders, masters, landlords, as well as receptors of the same, and that under a penalty of two hundred pounds."

These Acts plainly show the strict and careful conservation the Government took over the salmon fisheries; and under that attention and care the fisheries flourished and were productive of even more than the wants of the country required; for we find in ancient records, that apprentices in towns, farm servants, and labourers had a clause in the agreement with their masters *not* to be fed on salmon oftener than three days a week, and this was not only in the vicinity of large rivers such as are now known as salmon rivers, for in those days the merest stream that had connection with a river or with the sea actually teemed with salmon. The laws were good, and the conservators did their duty, and the success became far above conception. The Church as well as the State did their duty towards their vassals, for the temporalities were, at that time, one of their peculiar

cares. But where are we now? What has become of all the salmon rivers mentioned under the jurisdiction of these earls, lords, and town councils? have these rivers dried up and disappeared from the map of the country? We say certainly not. But the race of salmon then inhabiting these rivers have disappeared. Yes, the last one of them has been destroyed in more than the half of these rivers, and the other half are fast following. And we have nothing to blame for it but the departure from the wise and well-studied regulations of our forefathers, and the laxity of the Government and all those who ought to watch over the interest of these rivers. The Government turned careless of that part of the national property, and allowed interlopers to intrude and occupy what was the actual right of the Crown; these interlopers erected illegal machinery on these parts, in direct opposition to the spirit and intention of all the many previous wise acts of the legislature; and when challenged for doing so, they still persisted, and got part of a famous class of lawyers, who endeavoured to put a new construction on the wise and powerful deeds of our forefathers, under which *all* rivers were so prosperous. Some of the reverend class of the country took no ordinary part with the lawyers; for, when they should have been more creditably employed, we find them wandering by river sides, plucking and examining the piles of grass, searching for sea shells and worms, endeavouring to turn these rivers into sea, so as to get these cursed inventions of fixtures set close to the spawning beds of the salmon. One of our cleverest Scotsmen said, as far back as 1827, that a reverend doctor gave his evidence in favour of stake-nets, just because there was a stake-net close to the manse. I have heard several clergy examined on fishing cases, but I have invariably found them on

the side of extermination. Some dozen years ago, I heard one of that class examined on a stakenet case, and he wrought harder than he had ever done in a better cause to turn an actual river into a sea; and when examined on the descending smolts, he said, "When they reach the tidal influence they seek the *bottom of low water* channel, and go along deepest water, and do not descend by the sides." He wanted to prove by that that stakenets did not extend to the course that the smolts kept on their way downward, and as these nets did not extend to the low-water channel, they would not catch nor intercept smolts and young fish, or the fry of salmon, on their way down. A jury of Edinburgh merchants could not swallow that theology of the doctor, for their idea was that the calf always followed the cow, and where there was water enough for an old fish there was certainly enough for a young one; therefore, the doctor's views of sea, rivers, and fish at that time ended in a bottle of smoke. But how unlike, in that part, was the conduct of the doctor to what we see of the Roman Catholic priests in the prosperous times of salmon fisheries: the priests were faithful conservators over all rivers near where they were placed, whereas the doctor's care was only a fish from the stake-net for dinner. Lawyers made many proprietors of fisheries believe that the Scotch Acts meant this, that, and the other thing; that, in these Acts, black was not black, nor white white, and that the fixtures in those days are not the fixtures in our days. But, whatever be the shape, name, or construction of a fixture, it signifies nothing if it is placed there for the interruption and catching of salmon, and must, therefore, come within the signification of the Act against fixtures, and should at all times have taken effect against such. But it in many cases happened other-

wise; for, from the construction put by lawyers and a host of trained witnesses, a jury but little acquainted with the case was often led to give an adverse decision, and thereby allow the illegality to proceed, which was the means of encouraging others to attempt the same unlawful proceedings, which were either allowed to go on or land in the same uncertain game in the Court of Session. These cases were so frequent that the sums of money spent defending lawful rights were immense; and the tedious and almost never ending proceedings in the Court of Session prevented many a small proprietor from attempting to defend his little property against the grasp of his more powerful opponent. Case after case of this kind has happened, until the whole salmon fishings in the Kingdom have arrived at the very worst state of management, and become ruinous to all those concerned in them, as well as an immense deterioration to the food of the country in general.

As soon as these doubtful cases began to disturb the regular proceedings on that part of property, and the decision of the Judges hung entirely on a technical expression, and not on the justice and intention of the law laid down for the regulation and protection of such property, then was the time for the Government to step forward and state the true expression in the case, and thereby prevent the ruinous expenditure of money that has taken place throughout many years, as well as prevented salmon rivers from becoming barren wastes. But such was not the case: all our governments have looked on with perfect apathy on the whole transactions, and never one member has come boldly forward to the rescue. Part of the legislators have even embarked in the unlawful proceedings, and some of them have descended so low and degraded as to kill the salmon on the spawning

beds with *torch* and *spear;* some have even refused to convict salmon poachers who were actually caught in the very act of destroying the breeding fish; and now, in place of sheriffs and justices being the conservators of rivers, an unfortunate fisherman finds the utmost difficulty and much expense to get a conviction before these functionaries. I am perfectly aware that I will procure enemies for these exposures; that I cannot help, for what I state are facts, and will only say, *Them that's not scabbed need not claw.* Under all these untoward circumstances the whole fishings continue to degrade from bad to worse, and even half the rivers, as we have already seen, have become fishless; and although the case was still dormant at head-quarters, many now began to feel the effects of it from their *purse-strings.* Rents of fishings fell lower and lower; and tenants of fishings, who had struggled on under neglected laws until some of them had lost fortunes and the whole of them had lost their *all,* now became bankrupt, the fishings became tenantless, and many of the proprietors were forced to fish their own waters at a serious loss and no rent. This had the effect of the introduction of several *milk and water* bills into Parliament, none of which created any interest in the country, and of course were not supported by one party or other; for it was easily seen that none of them touched the root of the evil, and some of them would have legalised the main mischief and done little more. In 1828 Mr. Home Drummond introduced a bill, as it was termed, for the Preservation of the Salmon Fisheries in Scotland; it was carried through that session, but it has made ill worse, for it has changed the time of opening the fishings from the 10th of December to the 1st of February, thereby entirely excluding the fishermen from the profits of the early salmon, and the country at large

from the benefit and pleasure of eating them. This clause in the bill might have been inserted by Mr. Drummond from the best intentions, from expecting these early fish to become early breeders; but it is established without a doubt that the salmon that go up rivers early in the spring are not breeders for that season, at least not until they go to the sea and return to the rivers at a later period. The bill also changed the close of the fishings from the 26th of August to the 14th of September, which is the very worst and ruinous part of the bill. It is well known by all who have in the least studied the habits of the salmon, that the principal and best part of the breeders go up the rivers from the 20th of August to the latter end of September; indeed, very few come up after that time; therefore the present law allows the best part of the breeders to be killed, and particularly those that spawned early, returned soon after spawning to sea, and were back to the rivers in winter and spring. A few years told plainly that, from the effects of that change, early salmon had entirely disappeared from the rivers, and now not one in twenty are got during spring in rivers that were formerly very productive. These facts are clearly seen by all concerned in salmon fishing, and the case was so ruinous on the Tay that the proprietors of that river by mutual agreement now close their fishings on the 26th of August. But we may ask why such an Act should be left one day on the statute-book, when it has been proved without a shadow of doubt that it has been ruinous to both public and private good?

In this Act, the penalty for fishing in closetime is from one pound to ten pounds for each and every offence; from one pound to ten pounds for killing smolts and the fry of salmon, or disturbing the spawning beds; from two pounds to ten pounds for

catching salmon by torch light; and from one pound to two pounds for each black fish or kilt so killed; these penalties, though much more lenient than what are prescribed by the old Acts, if strictly and fully put in force might be useful so far in protecting the rivers; but where now is the public prosecutor instructed to put them in force? Of course we are told we can prosecute before the sheriff or justices; but in place of that the sheriffs and justices should be the principal supervisors, and all such prosecutions at the public expense, and not by private individuals: for if a private individual fail in getting a conviction once, the same individual will rarely attempt it a second time, for the whole expense of the prosecution falls on his shoulders, and that expense is never found to be a trifle.

Another bad feature in this Act is, that it has left out altogether any remedy for the removal of fixtures; they are all allowed to stand an invincible barrier to the progress of the fish from the *first day of February* to the *fourteenth day of September*: Sunday and Saturday the same, there they are catching, destroying, and turning back to the sea. Salmon clean and foul, young and old, must finish their course among the meshes of these destructive engines: they have no means to escape, for the one placed after the other, and always in the principal track that the fish run in, is certain destruction, and very few escape to fall to the rightful owners of the salmon. The whole salmon fisheries in Scotland at one time was the property of the Crown: some individuals got grants of fishings along with their lands: but these grants were given under the express understanding that these fishings were to be strictly protected according to law, so that the produce might be useful for the benefit and support of the community; these

rules were certainly well attended to until the laxity of the Crown allowed others to usurp their right: they allowed those who had no right to do so, to erect means and devices to keep the fish from those that had a right to them from the authority of the Crown. We must always keep in view that lands and salmon fishings in Scotland are two distinct properties, and often we find the land given to one, and the fishings on the same property conveyed to another; therefore, those that got lands without fishings on the banks of estuaries and firths, in course of time *took* possession of the fishings also: the one followed the example of the other, until now the whole property of the Crown is fully occupied without grant or allowance; and, what is even worse than taking possession of the property is, that they occupy that property in an unlawful manner; they catch the fish there by unlawful and strictly-prohibited inventions; they deprive the rightful owners, who have the care and protection of the young, and a lawful right to them when they grow up; in short, they are the root and foundation of the present decline and almost failure in our salmon rivers. But I suspect Mr. Drummond, if he was fully aware of all these facts, found them too cumberous a task to grapple with, and therefore left them out of his bill altogether; but I have no hesitation in saying that some one, sooner or later, must take the task in hand and perform it thoroughly, or the prosperity of our salmon fishings is gone for ever.

The rapid decline of the salmon was for a time more keenly noticed by naturalists and sportsmen than it was by proprietors who had a more direct interest in that decline; for as long as the failure only touched the pockets of tenants, and did not affect rents, the case remained unheeded, notwithstanding the many efforts to arouse them to a sensibility of the

fast approaching ruin. Men of talent and experience travelled, examined, and tried to discover a remedy; the habits of the fish were more perfectly discovered and known, and by artificial breeding and marking the young as well as the old fish, the time they remained in rivers and in the sea is perfectly known now. But for all the discoveries made, and fishings in the most deplorable state, nothing could arouse the Government and the Legislature of the country to even attempt to stem the current of destruction. Many gentlemen of the press endeavoured even to force on the country the necessity of immediate reform in the existing laws, but without effect; for it seemed as if those that had the undoubted right to protect the fish had conspired together for their actual extermination; at all events, they looked on the departing race with the utmost coolness and composure, and still nothing is done.

I have, for many years back, written in several of the leading journals of the country, exposing the state of the laws, and endeavouring to convince proprietors of fishings that their property was fast disappearing. At the same time, I have observed and closely watched the habits of the salmon, and experimented on both young and old, endeavouring to discover their uncertain proceedings as clearly as possible. I repeated the observations and experiments year after year, until I was convinced of their accuracy; and being aware that the discoveries would be useful to those interested in improving rivers, as well as to a certain class of honourable naturalists, in 1848 I wrote a pamphlet, stating part of the facts I had arrived at, some of which may not be out of place to repeat here. I will therefore begin with

Natural Spawning.

From the earliest ages it has been known that salmon ascend rivers for the purpose of depositing their spawn. That same knowledge induced our forefathers to fix on a season of the year for that purpose, and they did so at the exact time that nature had fixed on. They did not sit down, in council combined, and agree that we will make seed time in harvest, and harvest in seed time; no, the legislators in those days followed the advice of Solomon, viz., "In the multitude of counsel there is wisdom;" and they gathered together all those who had knowledge of nature's laws, and those who from long observation had noted the time the first fish was seen approaching the spawning ground, and who could likewise state the time that the spawning operations were generally brought to a conclusion, and from these alone they were able to fix the exact and suitable closs and open season for salmon rivers. The same precision could be arrived at still from the same materials; but now we want altogether that perseverance that is necessary for the purpose, and we now have so many absurd theories mixed in among the facts, and all these from illegal quarters, that it really puzzles the well-intended part of the legislators. To be a sort of cloak to their depredations, those who deal in stake-nets and illegal fixtures endeavour to assert that salmon spawn in the sea, and that they only catch the fish that are bred on their own coast, and not the fish that are bred in rivers. Such false assertions, from men that know quite the contrary, are sometimes a stumbling-block in the way of many who have good intentions, and wish to act honestly towards salmon rivers. If allowed the free course

of nature, salmon would begin spawning early in September: I don't mean to say that all the fish would begin at that time, for many of them have not left the sea at the time others are on the beds, but the first part of them would begin at that time. The first that are seen at operations are generally a few grilses that have escaped the snares and traps of the fisherman, and always near the tops or uppermost fords of the rivers; and for a few days previous to their going on to the shallows, they are seen in the stream immediately below that shallow, and at that time the lure of the angler always proves deadly. The fish, being then in a poor and hungry state, will catch at any thing in the shape of food; and there the ungentlemanly sportsman, and the poacher, exercises the unmanly game, as he thinks successfully, by taking out fish actually at the spawning. These first fish are soon accompanied by more, which numbers increase, by one shoal succeeding another, and by all the fords and shallows farther down the river being occupied, up to the 1st of December. From the 1st of December, on to the middle of March, the numbers are seen decreasing on the fords, in about the same proportion as they are seen increasing from the middle of September to the 1st of December. The greatest throng of the operations always take place from the middle of November to the middle of December. The fish always approach the spawning beds in pairs; one male and one female go together and occupy the same bed; but they differ a little from some other parts of creation, for, in this case, the female has the honour of selecting the male (I suppose to her own taste), and if the male should chance to be destroyed—as is often the case—by poachers (for the male seems not so timid as the female, and stands the approach of the torch better),

then the female leaves the bed, and proceeds down stream in search of another, which she invariably finds—at least she often does, although she has, at times, been seen returning with a trout when nothing larger could be got. When the pair first ascend on to the shallow, they can be seen moving about from place to place, doubtless selecting the exact spot whereon to commence operations, and when that is fully agreed on, the first work is to dig a hole among the gravel, for it is only on solid banks, and not among shifting gravel, that they deposit the seed. This hole is dug by the fish falling down a few yards below the selected spot, and, with a run upward, forcing their heads in among the gravel, and by that means part of the stones and sand are removed, and the current of the stream assists in carrying it downward. This process is continued by both fish alternately, until the hole is deep enough to receive the first part of the seed. These holes vary from nine to eighteen inches in depth, according to the hard or soft bank they are formed in; but the hole being of sufficient depth, the female approaches and deposits the first ripe part of the ova. As soon as that is done, the male immediately impregnates them with the milt. A careful observer can see both the ova and milt falling into the bed, and as soon as it is fairly settled in the bottom (which is in course of a few minutes), the fish again begin to dig up against the stream—not across, or down stream, as some suppose, and with the assistance of the water, the new removed part of the gravel covers the seed that has been laid. As soon as another part of the bed is deep enough, they go through the same process of spawning, and continue digging, spawning, and covering, until the whole seed is deposited. The works of creation are beautifully displayed in the breeding of

fishes, for nothing is done at random, but every department of it is done in the most mechanical manner; the one knows from signs or motions, or some other mysterious instinct, what the other intends to do, and the work is all throughout carried on with the greatest order; and although many pairs are seen on the same ford, unless some of them, in falling back or coming forward, approach too near their neighbour's beds, when a battle ensues between the two males, nothing disturbs the beautiful operations of the work.* Some

* Among those who believe that the artificial breeding of salmon is all in all, we find a deal of fanciful imaginations—one of which is, that when there are too many breeding fish in a river, the one pair is sure to dig over the seed previously deposited by others. But I should like well to know who ever saw too many breeding fish in a river? It is entirely owing to the scanty supply of breeders, as well as the unnatural time they are allowed for breeding, that we so much complain of. Give us Nature's laws, and abundance of breeders, and we ask no more. We shall then have no need of artificial productions, nor any assistance to the works of nature. I do not mean here to say, that I have seen all the world; but one thing I will say, and that is, that I have seen many a spawning ford, in the course of the last forty years, but never yet have I seen one fish turn over the bed of another. It is not enough to imagine, and then say that fish are likely to do such a thing—that is not the question; for I would ask candidly, Did any one ever see it done? It is a well-known fact, that salmon have never been known to spawn among loose or newly-turned gravel; they invariably begin their beds on a hard and solid gravel bank. Nature teaches them to select the spots that are not likely to be overturned, and where, in ordinary states of the river, they are not liable to be disturbed; whereas, were it the soft and easily-turned spots they inclined to fix on, they would invariably fix on the last-covered bed, and never undertake the difficult task of boring their noses into a hard gravel bank, when there was a soft spot beside them. We are told that such and such a ford is completely ploughed over; if such were the case, the first flood would certainly carry off the whole—sand, gravel,

not very careful observers supposed that the spawning bed was dug out by the tail of the fish. This supposition rose entirely from seeing the tail-fin a good deal worn after the spawning process was finished; but that fin is not worn by digging the hole; it is worn merely by rubbing against the sides of the bed when forcing the head of the fish up against the gravel. A fish cannot exist long if the head is kept down stream: how, therefore, could we imagine that a fish could remain in that position, and force its tail up against the gravel bank? It is impossible, and entirely against nature. Whenever the spawning operations are finished, the parent fish leave the beds and incline downward; they fall back to the first deep pool below the bed, where they rest for a considerable time, and then fall back to the next pool further down the river, and so continue resting and falling back until they reach the tideway. In general, the males are the first to leave the river, for many of the females continue there till the April following, and from that arises the fearful havoc of kelt killing we see in the Tweed and various other rivers. How long the salmon remain in the salt waters before they return to their native streams has been a keenly contested mystery for many ages. Some said that they fed in the Northern Ocean, and others said they went to the Polar Seas, but all parties spake from

and seed. But such never was the case. I have seen the fish pretty throng on a ford, but when the whole operations of the season were over, and the spawning finished, there was double the space untouched, that was turned over. I mention these facts merely to prevent well-wishers of the salmon, particularly those who may not have had full opportunities to judge for themselves, from being led into any wild, fanciful, and impossible imaginations; for when salmon fishings were in their full glory, there were never too many breeders, and even then, the one never turned over the other's bed.

mere imagination. Therefore, in 1834, I commenced a system of marking the spawned fish, by inserting copper wire into the fin. This was for the two-fold purpose of ascertaining if the fish returned to the same river, and the length of time they were absent from the time they left the river in the foul or kelt state, until they returned clean salmon. I kept a register of the days on which they were marked, and the various marking days were distinguished by inserting the wire in a different fin of the fish. This we continued to do for several years, and the result invariably was that the fish returned to the river where they were marked; and although five good salmon rivers fall into the same estuary, the marked fish were invariably found in the rivers where they were marked; and although these five rivers fall into the same estuary at different places, and the fish of all these rivers come up the estuary for twenty miles promiscuously together, each river has its own peculiar race of fish, and each race finds its own river with the most perfect decision.

The first of these rivers that fall into the estuary, has a run of well-shaped salmon, whose average weight is about ten pounds. The second has strong, coarse scaled, rather long to be well shaped, but very hardy salmon, whose average weight is about seventeen pounds. The third river has a middling shaped salmon whose average is about nine pounds. The fourth river has long ill-shaped salmon, averaging about eight pounds. And the fifth river, although the smallest of the five, has fine shaped fish, averaging fully fourteen pounds; and although the fish of all these rivers mix together, and all travel together on the common road to the sea, feed there promiscuously on the common feeding-ground, and then return by the same common path, each party finds out its own

home with the greatest precision, for scarcely ever is one of them seen in its neighbour's possessions. This precision is yet a mystery among many others, for although we see rivers of different temperature arising from the size or situation of the lakes from which they are fed, we find others of the same situation and temperature, and yet the fish must know a distinguishing quality that leads them to their own native streams. It is true that salmon have their summer and winter courses for travelling in the same river, and that is also kept with the most exact precision; for in winter, and up to the 1st of May, salmon invariably run up the north side of rivers, whereas from the 1st of May to November the fish run on the south side. We have now shown that salmon undoubtedly return to the rivers where they have spawned, and where they belong to the race of fish that inhabit that particular river. It may be, that they know their own race, for a river has at all times plenty of the young fish, as well as the old, either clean or foul: be that as it may, it is evident that they go there, and to no other.

The large majority of fish that I marked were absent from the river only two months, out and in; they were only two months in going to the sea in their foul lean state, feeding there till they found themselves fat and fully satisfied with the abundance of food the sea produced, and in returning to their native rivers: of course among these we found some exceptions, for few of them might have remained in the river for some time after they were marked and registered, and some of them might have left the sea sooner than the time required by the larger body of them, which cases would produce the exceptions to the general rule. But with these exceptions the time of their sojourn will be found most correct. The most rapid return

yet on record is that of one fish marked by his Grace the Duke of Atholl some years ago. His Grace writes: — "On referring to my journal, I find that I caught this fish as a kelt this year on the 31st of March with the rod, about two miles above Dunkeld bridge, at which time it weighed exactly ten pounds, so that in the short space of *five weeks and two days* it had gained the almost incredible increase of eleven pounds and a quarter, for when weighed here on its arrival, it was twenty-one pounds and a quarter." The fish referred to here was caught and marked upwards of forty miles from the sea; it had to travel that length, feed, and return in thirty-seven days. There could be no doubt of the accuracy of this short sojourn, for his Grace was most correct in his transactions on these points, having tickets made for the purpose, and numbered from one upwards, and the number and date registered; therefore, we find this fish marked "No. 129.," and the date entered in his Grace's journal. From these facts we cannot entertain the idea that fish go either to the North Sea, Polar Seas, or Norway, to fatten; foul fish, when they go down go northward to feed, and this being seen when their habits were more imperfectly known than they are now, might produce the idea that they travelled on to these distant regions. But now, when it is known that their absence from the fresh water is so limited, we must give up these ideas entirely, and conclude that, although the fish on entering the salt water turn northward, their journey can only be along the coasts and sea bays, and such feeding-places where they find abundance of small fishes and fry, and where, from being endowed with such power of digestion, they soon get into that state of corpulence that a return to their native rivers is desirous, and must also be agreeable to their taste, notwith-

standing the scanty supply of food they can get in these rivers.

My next attempt was to ascertain the rate of their growth during their short stay in salt water, and for this purpose we marked spawned grilses, as near as we could get to four pounds weight; these we had no trouble in getting with a net in the pools below the spawning beds, where they had congregated together to rest, after the fatigues of depositing their seed. All the fish above four pounds weight, as well as any under that size, were returned to the river unmarked, and the others marked by inserting copper wire rings into certain parts of their fins: this was done in a manner so as not to interrupt the fish in their swimming operations, nor be troublesome to them any way. After their journey to sea and back again, we found that the four pound grilses had grown into beautiful salmon, varying from nine to fourteen pounds weight. I repeated this experiment for several years, and on the whole, found the results the same, and, as in the former markings, found the majority returning in about eight weeks; and we have never among our markings found a marked grilse go to sea and return a grilse, for they have invariably returned salmon. We have now followed the spawned fish to the sea and back again, and marked their progress during that time. But before leaving the breeders, we may just observe, that a plentiful spawning time, as is seen in some seasons, when floods occur, often in July and August, and when the upper parts of rivers are perfectly full of fish, will never produce numerous crops of smolts and grilses, unless it be accompanied with other favourable circumstances. We may see a great abundance of breeders, and yet the rivers, during a great part of the spawning season, not in the proper size to receive the seed to advantage; it

may be too much flooded, so that the fish may be forced to deposit their seed on banks that are always dry in an ordinary state of the river; therefore, that part of the seed is lost; or the rivers, by means of a continued frost, may be low, and the principal spawning fords ice-bound from top to bottom, as often happens in December: in that case, of course a great part of the ova must be lost; for, although the fish have the power of spawning when the seed is ripe, they are entirely devoid of the power of retaining it after a certain time. Or if large floods should happen at the latter end of the throng time of spawning, particularly if it does so before the beds are fairly covered up or sadden down, they are liable to suffer a good deal from being carried away. In 1848, the northern rivers were actually full of fish during summer and harvest, — no fish being caught in the rivers that summer; the first part of the spawning season was good, and the operations were very satisfactory. But the awful floods that happened in January following carried off banks and beds, and swept the whole seed into pools, where it was covered over by the *débris* of the flood, and thereby lost. We have now described the spawning process, and left the seed covered up in the beds, so as to follow the parent fish down the river to the sea, their feeding-ground, and back again to the native river, also describing their progress and growth during that time. We shall now return to the

Spawning Beds.

We have already said that when the ova is deposited and impregnated by the milt, it is covered up among the gravel, and left entirely uncared for by the spawned fish. Whether nature has formed these fish with an idea of the time their young require to

lie in this hidden state, before they appear abroad in the river, is not certain, but still not unlikely; for when we consider with what extraordinary precision they perform all their actions, we must undoubtedly conclude, that migratory fishes are one of the powerful works of creation. It is not unlikely, that when the parent fish have satisfied the cravings of poverty and hunger among the banks and bays of the ocean, that instinct may lead them back to the rivers where they left their seed. However, the seed lies in these beds until many of the fish have returned to the rivers; and it is always the case that first spawned first down, and first down first up.

The ova deposited in September will be hatched in course of from ninety to a hundred days, for at that time the temperature of the water is high, and the length of time that the ova lies among the gravel entirely depends on that temperature; whereas the ova deposited in December, and after that time, will lie among the gravel 140 days, if the winter be severe; and, moreover, the late spawned ova has to suffer many disadvantages that the early spawning never meets with. When the fry bursts the shell of the egg, it is an unshapely thing about three-fourths of an inch long, and more like a tadpole than a fish, with a conical bag, the colour of the yolk of the egg, attached to its belly; this bag is so large, and the fish so small at this time, that the fish must lie on its side beside the bag, and cannot lie on its belly, although when in the act of swimming, which process it goes through with great alacrity the moment it is excluded from the shell, it carries the bag fair under it, but turns on the side whenever it halts. There they are in this helpless-like state scattered over the bottom of the water, and when lying still they can only be discovered by the bright-

occurred with individuals reared in similar ponds supplied with water from a rivulet, the temperature of which throughout the year ranges pretty nearly with that of the river Nith.

This plainly tells that there must have been some derangement from the temperature of the water, and also other unseen causes, whence some arrived at the smolt state at the end of one year, and others not till the end of two years. This may be caused from confinement in the ponds, and the limited quantity of food that can be gotten there in comparison to what can be got in the open water. This, combined with an unsuitable temperature, very likely produced the slow progress of the fry in Mr. Shaw's ponds.

I erected a chain of four artificial breeding ponds on the River Shin. Each of these were about eighteen feet long, nine feet broad, and five feet deep, and supported on the river side by a strong stone wall, of a height above the highest flood mark; that wall was solidly packed together, so as to prevent the egress or ingress of the smallest insect from or to the river; the ponds were filled within with suitable gravel, and placed so as to have the depth of water one foot at the top or entrance to the pond, and four feet at the lower or farthest down end; at the entrance of the water from the river to the pond, a strong high wall is built, at the bottom of which is a drain about twelve inches square, strong and closely grated so as to prevent any *débris* from a flooded state of the river getting in. This drain also regulated the supply of water in all states of the river, so that the current in the ponds continued the same. The inside of the admitting wall was also grated, first with an iron grate, one-eighth of an inch apart, and then a narrow wrought wire grate, so that the smallest fishes could neither get in or out. The four ponds were erected

at about twelve feet distant the one from the other, and the same stream of water ran through and supplied the four ponds, after which it fell into the river by an artificial fall; so that no fish from the river could enter into the artificial stream. The ponds were also closely grated at the lower or outlet end, so as to prevent the fry from escaping from the ponds until required to do so; although at a certain age, I allowed them to occupy that part of the stream that connected the one pond with the other, and on a sunny day they seemed much pleased in that shallow stream. I also roofed over the ponds with wicker-work, to prevent the wild fowl or any other destructive vermin from getting at the young fish; and as soon as the ponds were perfectly ready, and the water running through them for some time, I set about

Collecting the Spawn.

This was done by dragging a net over the fords and spawning beds, at the time the fish were busy at their spawning operations, whereby we brought them ashore in numbers. We had a can with a little fine gravel and water ready for the reception of the seed; as soon as I got the fish ashore with my left hand, I held up a female fish by the gills, and by a gentle pressure with the fingers and thumb of the other hand down the belly of the fish easily caused the emission of all the ripe ova into the can. I repeated the same operation with a male fish, and as soon as we got the milt of that fish into the same can with the ova, I with the hand mixed the ova, milt, gravel, and water all together. This process I continued until I got the quantity of impregnated seed required, but never in any case trusting to the milt of one male impregnating the ova of a

number of females, as is done in some of the new artificial breeding establishments. The ova of a number of fish may be sufficiently impregnated by the milt of one male; but when we see fish in neat pairs in natural spawning, and if a pair be undisturbed during that process, the seed of the one is completely exhausted, as well as that of the other, in that case, I am inclined to think that the nearer nature we come in all artificial imitations the better, especially when the fact is known that an impregnated grain produces nothing. However, when we got the seed collected and mixed after the manner we see done in rivers by the fish, I set about

Depositing it in the Artificial Ponds.

I got a number of copper wire baskets made, with covers of the same material. Into these, mixed with suitable gravel, I placed portions of the seed, and sunk the baskets among the gravel at the upper end or entrance of the stream: these I covered over with two inches of gravel. Another portion I deposited among the gravel in the stream, and a third portion I deposited in a still part of the pond where there was no stream, which furnished the artificial planting for that season, and of course I eagerly watched the result, and for the appearance of the ova and its progress. We may just state here the account of it we gave in 1848: "The ova when extracted from salmon in the spawning time are of a pale or light blue colour, and about the size of a small pea. It is composed of a white shell, and a light red yolk, and from the crystalline nature of the shell, the inward parts of the egg are quite perceptible, and the yolk easily seen, the shell being full of pores or small holes scarcely discernible to the naked eye, which at the time of deposition fully pre-

pares it for the reception of the milt of the male fish, that being the only connection necessary between the sexes. The yolk of the egg at that time fills the shell to outward appearance; so that the egg then appears all of the same colour and the white shell is scarcely seen. But after the eggs lie twenty days among the gravel in the spawning bed, the yolk approaches more to white, which gives the egg a lighter appearance. And at this time a very small brilliant spot is discernible on one side of the yolk, which spot increases in size, so that by the time the eggs have laid thirty-three days among the gravel, the brilliant spot covers nearly a third part of the yolk. The remaining part approaches more to white, and exhibits the shell more clearly, so that the observer is very much interested in noting the visible alteration. The red spot grows larger daily, and when the eggs have lain forty-eight days among the gravel, the red spot has covered fully one-half of the yolk, and continues daily to spread more and more, and at forty-eight days the young fish make their first appearance within the shell, the appearance being an elongated formation of a blueish white in the yolk of the egg, and about the size of a small thread; and from the yolk being of a different colour we can see the formation more clearly daily increasing in size, and drawing more towards perfection. By the time the ova has lain in the spawning bed sixty-three days, the formation is at one end supplied with two very small but discernible black spots, which we afterwards find turn out to be the eyes of the fish. We have now a decided daily change; the young fish are getting larger; the black spots becoming more visible, and the brilliant red, which at one time nearly covered the yolk, drawing closer towards the fish, and leaving the other parts of the egg of a paler appearance, and the fish fully

double the thickness it was when it appeared first; the shell of the egg appears more thin and crystalline, so that we can see all parts of it perfectly, and can examine it more minutely. When seventy-nine days among the gravel, the above appearances have increased a good deal. The red of the yolk is less, and the eyes of the fish larger, the shell of the egg is more thin, and the young fish larger and filling more of the inward space, and easier seen. At ninety-three days, the shell looks a good deal distended, the head of the fish larger and better formed, the eyes seen more perfectly, and the red yolk leaving the back part, and drawing more closely towards the belly of the fish, where it forms into a conical looking bag, one end of which is attached to the belly of the fish below the gills. This appears yet more clearly at one hundred days deposited, for now we find the young fish alive within the shell; we see it turning over from one side to the other, and the shell getting very thin and distended; the above red appearance in the yolk is now fully formed into the conical bag, and attached to the neck and belly of the young fish, and when we see the fish turning over within the shell, we observe this bag turning over also. At this time, by taking a grain of seed along with a little water into the hollow of the hand, the heat of the hand raises the temperature of the water, which causes an immediate movement of the fish, whereby the whole formation in all its different parts are clearly seen, and sufficient time got to observe all the various alterations and progress, which at this time are very interesting. We now see the new generation of fishes all alive, although yet confined in their original cells. When we consider that these yet unshapely things, not more than half an inch long, will in eighteen months hence afford sport, and fill the basket of the angler, as well as the box of

the fisher, we cannot help reflecting on the absurd laws that prevent their increase to almost incredible numbers. At one hundred and thirteen days, the fish have increased; the head appears large in proportion to the body; the movements and turnings are more frequent and lively, and sometimes they appear as if they would not be much longer confined within their cell; but we find that they must yet be confined a little longer, for at one hundred and twenty-three days the fish are not yet at liberty, although they appear larger and more restless, and their turnings very often. We now evidently see that the bounds of the shell are too little for them, and from their movements it is plainly seen they are dissatisfied with the confinement, for now we have plenty of time to examine and see them at every turn almost breaking and bursting the shell. Although at one hundred and thirty-three days we see they have not got their liberty, but the fish are very restless and seeming as if they could not endure their imprisonment much longer, the conical bag being red towards the belly, but of a pale colour towards the outside, the fish still restless, turning often and quickly, and at every turn appearing to break from their confinement, the shell now being distended and thin. The time has now arrived when a change from bondage to liberty is eagerly looked for, and the observer continues anxious to look on. The myriads of young fish are continually moving from one side to another, and the whole bed seems in a state of convulsion. Such is their state now, that night only can force the observer to change his position; and from an anxiety to see the actual movement at development, he leaves the ponds with deep regret; but with quick and anxious steps returns next morning by dawn of day, fearing that the long-expected sight had been lost, but glad to find the beds

in much the same state that they were in the previous evening. The beds are watched all this day with the most intense anxiety, and yet night comes without producing the grand exhibition; all was motion, but none had yet burst the shell. However, next morning, the ova being now one hundred and thirty-five days among the gravel, the shells of the eggs were yielding and giving way to the pressure from within; numbers of them already burst, numbers bursting, and numbers yet remaining whole. This is the moment of anxiety; the long-looked-for period has now arrived, that of a new generation of fish being launched from a state of thraldom into one of liberty, and into their own natural element. They are now cast abroad among the waters, with nature for their only guide: to her provisions their parents have left them one hundred and thirty-five days ago, and she has formed them to thrive without nurse or protector, and sent them forth on a hazardous journey, provisioned only for five weeks, and she exhibits them in all their history and habits amongst the strangest and most wonderful works of creation.

The ova we have described above is the portion we placed in the running water, in the copper-wire baskets, and among the gravel in the stream; for the portion that we placed in the still part of the pond, I found completely addled and unproductive. In these the ova first turned white; then it gathered a white woolly moulding over them; and, lastly, it stuck together in one addled lump. I tried, also, unimpregnated ova, which I put into one of the wire baskets, and placed it in the stream, close to where the impregnated ova were, and it failed after the same manner as the impregnated ova that I deposited in the still water. I also, during a severe storm of frost, lifted one of the baskets from the stream, and

placed it where the ova, gravel, and water got frozen into a solid lump. I allowed it to remain there for three days, and then put it back to its former stream, and at hatching time I found that the only injury that the ova received during its frozen state was, that they were three days longer in hatching than the baskets that remained all the time in the stream. All these experiments we have tried repeatedly, and at all times have found them to produce the same results. Artificial breeding of fish has now become general in some rivers in Britain, as well as in France; but how far that system of producing fish will go to increase the numbers, or to keep up a national supply, has yet to be seen, for it is only yet on paper. However, with suitable laws and justice to salmon rivers, artificial breeding might, in course of time, become a supplimentary fund to natural breeding; but, in the present state of the laws, I beg to get the benefit of a doubt.

But, whatever effect artificial breeding may produce on the supply of a whole river, these experiments have long ago had their effects if rightly followed out; for what we wrote in 1848 are facts, viz., "The spawn of salmon is transferable, and can be carried from one river to another with the most certain reliance of success, and with no great degree of trouble. Only watch the spawning fords while the process of spawning is going on, and then get hold of a pair of fish who have actually begun their operations, take them ashore, hold them up by the head with one hand, and, with a slight pressure with the other hand over the belly of the fish, you will cause them to produce the whole ripe seed at once, which can be received into a can or other vessel, among a little gravel and water. This process should be gone through with the female first, and then with the male, so that the

ova shall be under the milt, and be certain to be impregnated with it, after the manner of the natural spawning in rivers, the ova at this time being full of small microscopic holes, and ready to receive the milt. The seed so impregnated can be carried for many miles, and deposited in any barren river that has a connection with the sea, and the success is sure; they will hatch, go to the sea in regular course, return to the same river, breed there, and increase to immense numbers, if they could, by any means, be kept from the "claws" of legislators. Half the rivers of the kingdom are barren at this moment, or the next thing to barren. Why should such a thing exist for one year? If they are public property, the thing is excusable—for what's all men's property, is no man's; but if those be private property, certainly the proprietors are asleep.

We find that the artificial breeding of fishes is not exactly a new science, for, ninety years ago, S. L. Jacobs wrote an account of experiments he had made on the spawn of fishes previous to the year 1763, in the form of a letter to the editor of the "Hanover Magazine," in which he says:—

"Sir,—I have thought it a duty incumbent on me to lay my observations on the breeding of trout and salmon, as well as on other subjects, before the public. It would be needless, and not to my present purpose, to mention every trifling experiment which I have made the last sixteen years, before my discovered invention, and in twenty-four years more afterward, on the artificial increase of trout and salmon. Perhaps I may be induced to give a more circumstantial account on this subject. The box, trough, or water-bed, in which the eggs, animated with the milt or sperma of the male trout, are scattered, needs no par-

ticular form. Yet it will be necessary to give a description how those that I use are made.

Section I.

"1st. I had boxes made of various woods, but I found oak to be the best, about twelve feet long, one foot and a half wide, and six inches deep.

"2d. At the head of the trough, where the water is to run in, is laid a thick board, about two and a half or three inches thick, about a foot wide, and as long as the trough is wide. In the middle of this board is made a hole, six inches long, and about four inches wide in the clear, with a ravet on all the four sides of this hole, about an inch and a half wide and deep, so as to admit of a square frame with an aperture of six inches by four inches, or of the same size as the hole, which frame must be covered with a brass grating of a moderate strength, and close enough to prevent the smallest water-shrew from passing through, otherwise all the spawn and young fry will be in danger of being devoured by them.

"3d. Near the middle of the box or trough lay another piece of thick board across, as long as the width of the trough, and about six inches or more wide, which, when nailed upon the edges of the side-pieces, will keep them more steady and firm.

"4th. Let the lower end board, where the water is to run off again, be at least three inches thick, as the greatest pressure is against it. Have an opening cut at the top six inches wide and four inches deep; have a ravet made on the outside and another on the inside, deep enough to leave at least an inch thick of the solid board in the middle, and wide enough to admit a frame with a brass-wired grate like No. 2, on the outside, which can be pushed in from the top.

The wires should not be above a line and a half asunder, no more than those at the top, for the same reason as mentioned before. In the inside, opposite this opening, push a bit of board downward into the groove to stem the water, either entirely, or to regulate its running off, according as you find it necessary, or to pull it entirely out when the whole of the water is to run off.

"5th. There must be two strong covers, one between the two cross-pieces described in 2 and 3, and the other below the middle cross, quite to the lower end. Both covers must be fastened behind with strong hinges, and before with handles, to lift them conveniently up by; and as these boards are apt to warp, on account of the water within and the air without, it is requisite to have each clamped with two or three cross-pieces.

"6th. If you think fit to give the young fish more air than what enters at the two brass grates, you may have in each cover a hole made of the same size, and guarded with a brass-wire grate, as in No. 3, and for the same reasons. I have done this out of precaution, but have found it in the end to be unnecessary.

Section II.

"1st. Spring-water, out of rocks or stony ground, is the properest for breeding of trout or salmon; but where it is not to be had, other spring-water may do, provided the current is strong enough not to freeze in hard frosty weather.

"2d. If the spring has not fall enough, you must raise a dam around it one or two feet higher than the top of your trough; convey the water from thence, through a pipe or gutter, to the first grate in the opening on the head-part of the trough, of one square inch

diameter, and determine its length at least two inches above the grate: the remaining water from the spring can be led off sideways.

"If you have an inclination for more breeding-troughs than one, they should be fixed in the same direction as the first, and a large pipe must be placed to the head of the spring, which must empty itself into smaller pipes laid across the water troughs, so that each trough may have its proper quantity of water conveyed into it; or it may be managed by means of brass cocks; but this is left to the choice of every one's own pleasure, as the most convenient method will soon be found out.

"3d. After the box or trough is properly finished, it must be placed horizontally upon two logs of wood, stone, or brick, and within, upon its bottom, put some clean washed gravel, about the size of peas and beans, two inches high; afterwards sprinkle some coarse gravel or pebbles over it, the smallest of them the size of beans, and some larger than hazel-nuts. This last is done that, upon the surface of the gravel, many deep holes may be formed, that the continual motion of the water may not carry away the eggs, but that they may remain where they were at first sprinkled in.

"4th. Then let the water run into the trough, as directed in 2, and raise it higher or lower, according to the instructions in Section 1st, so that the water covers the gravel always one or two inches. This done, you have accomplished all that is necessary to the apparatus for breeding trout and salmon.

Section III.

"1st. The time of spawning begins the latter end of November, and commonly ends the latter end of January, or beginning of February; but the spawning time of each separate trout continues only about eight

days, as the eggs of the female and the sperma of the male become in some sooner and in others later ripe. Trouts meet in great numbers, in rivulets, in the before-mentioned months, and such as are ready for spawning, fix upon a place where there is large gravel, and where the water has a quick current: there they rush, and rub their bellies against the stony bottom, and so violent that they often make great holes, and by means of this motion both female and male get rid of their spawn and sperma.

"As a single drop of sperma contains great numbers of animalculæ, sufficient to animate hundreds of eggs, and as the water is loaded at this time with the sperma, it is no wonder that almost every egg becomes a fish. Every egg or spawn in the female comes to its perfection and ripeness at the same time and day. But it is not so with the sperma of the male, for the sperma or white roe lies like a solid substance divided into two parts in its body close to the back, and grows gradually liquid, and dissolves itself into a creamy fluid, beginning at the lowest part, and discharges about the sixth part of each division every day, so that within eight days all the sperma becomes liquid and runs off.

Section IV.

"1st. To breed young trout according to this invention, you must have some trout taken out of the rivulet in December and January, when they gather together to spawn, as in some rivulets their spawn becomes later ripe. You may in the latter end of January let part of the water; by stemming the water above that you may take as many out as you want: if, after stroking their bellies with the fingers, some spawn or sperma goes off, it is a sign that both are

ripe, and those must be put into a large pail or tub for use. Then a wooden, earthen, or copper bowl,—put into it a pint, quart, or more of clear water; take out of your pail one fish after another; stroke them with the hand or fingers downward, till the spawn discharges into the bowl: you need not fear that it will hurt them, for they can without danger bear great pressing. Then rub the belly of the male trout in the same manner, till some of its milt discharges into the water—a little is sufficient; then stir the whole with your hands so as to mix it well, and all the eggs and spawn will be fructuated. Then mix more clear water with them, to disperse them more asunder. After the eggs are impregnated with the sperma, they are apt to clog together, which hurts them in the end. It is therefore necessary to thin them with more water, and to sprinkle them into the breeding troughs. A small space will receive a great quantity of spawn, yet they must not lie too thick, otherwise, where many touch each other too closely, they will get in a few days into putrefaction, and have the appearance us if a fine downy wool was spread over them; if they remain in this state they are unfit. To prevent this, take a thin slice of wood, or a paddle about the breadth of a hand, and paddle with it backward and forward where the spawn lies too thick. To spread by this motion the spawn asunder, it will be necessary to repeat this manœuvre twice a week, or at least once a week; and by paddling with your wooden slice in all parts, you will bring the water upon the eggs in motion, for let the water be ever so clear, there will adhere to the eggs in a few days a subtle filth, which lays the foundation of their corruption, even when the young fish are already alive in the egg; therefore, it is necessary to clean them by this gentle means. After the eggs

have been about three weeks in this state, one may perceive through the hard skin a divided black spot, which are the eyes of the young fish. The body is too transparent to be seen with the naked eye, but after four weeks, if you squeeze one of the eggs between your fingers, you will see the fish make a motion, and turn within; then you perceive his form.

"At last after lying five weeks in this state, and under a continual current of running water, the young fishes will bare their heads through the shell of the egg; and under motion with their bodies, will, in about half an hour, free themselves entirely from the shell, with the yolk of the mother-egg hanging to their bellies like a small bag. So soon as they are out of the egg, they will still lie in the cavities between the gravel, and have then the appearance as if the head of a pin was fastened to a reddish field pea, on account of these hanging bags. For three or four weeks they receive their nourishment from the substance contained in this bag, till by degrees, as the fishes grow larger, the bag disappears; then they begin gradually to assume the shape of fishes, and having no further sustenance from this bag, they will seek for food themselves. But as in so small a compass as this breeding trough, there cannot be a sufficient quantity of small insects to be found for their sustenance, they seek for more room, where they may meet with them in greater abundance; they follow then the current of the water, and slip through the brass grate at the end of the box, where you should have a large wooden tub, like a brewer's cooler, or a small clean fish pond covered with gravel, to receive them, in which they will grow in about six months considerably.

Section V.

"To instruct my readers as much as possible, I shall add several observations on the formation of these young trout. After the egg has been fructuated by the sperma of the male, which slips through an invisible opening into it, it lodges in the white liquor under the shell and round the yolk, which last is liquid and transparent, tending to a yellowish colour, and seems to fill up the greater space of the egg, except the little white round it. So soon as this little animalcula has assumed the nature and form of the fish, it appeareth that the yolk of the egg is separated by a very thin skin from the outward hard membrane. The fish itself, except the eyes, is very transparent, and as liquid as a little mucilaginous water, yet in shape longish: it lies bent within the outward hard membrane of the egg, and round the thin skin that covers the yolk. From this time the fish is to be considered as one body, to the yolk from the gills downward to the outlet, which is in length about the quarter part of the inward circumference of the egg. This yolk, which looks like a bag, becomes the belly, and without entrails. On this expanded belly, especially in the salmon trout, are plainly to be seen many blood-vessels divided into smaller branches, and so plain that the arteries may be distinguished from the veins by the naked eye. And it is no wonder, for as it has been mentioned that this hanging belly is larger in proportion to the fish, so that the blood-vessels are in proportion expanded, and are to be seen very plainly so long as the fish remains in a state of transparency in the water. If you open one of these bags with a needle, a liquor runs out of a yellowish colour, which is the nutriment of the fish; then the

bag shrinks in like an empty bladder, and the fish dies. After the fish has been out of the egg for about a fortnight, a thin skin separates from the inward coat of the hanging belly, and then it shrinks so much that it appears as entirely vanished. After the belly has entirely shrunk to its proportionable size, this inward skin shrinks likewise and becomes the intestines; from the mouth it forms a passage into the stomach, and continues more narrowly contracted and formed into intestines which lay one over another to the outlet of the belly. It is further to be observed, that the heads of the trout, when they first have the heads of fishes, have not yet all the usual shape or form: they look as if the snout was chopped off near the eyes; but as their bellies shrink, their heads grow, the mouths are formed, and after about three weeks the heads get the proper shape. Lastly, I shall make a few additions which flow from the former observations, and are the results of experiments which at this present occasion I have no inclination to publish.

Section VI.

"According to the course of nature, no trout or salmon are generated in ponds or standing water. They cannot be bred there if millions of pregnant eggs were put into them. The young trout have for the first two or three weeks a great tenacity of life; for after the head is dead, the body will live two days before they are quite dead: this is to be understood of healthy fish kept in a current of fresh running water. Although the young trout have to swim with the current within the six weeks out of these breeding troughs, yet they can be kept within them, six or more weeks longer by particular management. They

are not easily caught on account of their small size and rapid motion; notwithstanding, they may be collected in a pail. They may then be put into proper water, or can be put through a funnel into bottles, and carried to any part, provided the water do not freeze. The ripe eggs of a trout, after they are four or five days apparently dead and gone into a kind of putrefaction, so that the stench is intolerable, may yet be recovered and bred into fishes. The eggs of trout will not produce fishes, so long as they remain connected with the egg stock. The natural causes why it is possible for a hen to bring a live chicken into the world may very easily be accounted for from observations I have made in the breeding of trout. The natural disposition of the animalcule of the sperma which enters the egg, may be considerably increased. I have made many experiments in which I have found that two animalcules have slipped into the egg, and that double fishes have been generated; and although they had two bodies, they had but one common stomach. How this happens, see Section 5th. Of these monstrous productions, the most of them were opposite to one another, and had their stomachs in common between them, and yet in a strict sense the stomach only: the rest of the intestines divided in about three weeks separately. Some of these double fishes were fixed by their sides together, when two animalcules enter the egg in a direct line 90 degrees from another. I have seen only one of these double fishes where the backs were crossed nearest the tail in a direct angle, so that this fish formed a kind of cross. This happens when two animalcules enter one egg, and are placed opposite each other from their direct line to 90 degrees. The monsters above were grown together from the head to the opening of the belly, and that had in some degree a joined body, but

the backs were distinguished the one from the other. All this kind of monstrous productions die in four or five weeks after their joint bag or belly is emptied; for as each endeavours to follow its own direction in pursuit of food, and both hinder one another, neither of them is capable of performing its intentions: it is impossible that either head can receive its proper nourishment, therefore they must starve. All monstrous productions in the human and other animal creations, with a joint stomach, are produced where an egg is fructuated by more than one spermatic animalcule.

"All observations made on trout and its artificial method of breeding hold good with regard to salmon.

(Signed) "S. L. JACOBI."

I would not have inserted Mr. S. L. Jacobi's letter at full length, had it not been for the last paragraph, in which he says, "that all observations made on trout and its artificial method of breeding, *hold good with regard to salmon;*" for although he has given a full account of boxes or troughs, and the breeding of trout, his observations differ materially from what we find in the habits of salmon; for spring water from rocks, or a hard stony bottom, *is not* the best for breeding salmon in; for salmon know their own rivers by the water or otherwise, and they spawn there naturally; and of course the water from that same river must be the best to breed them in artificially. The spawning season in Germany seems to be much shorter than ours, for the letter says that it is only from the latter end of November to the latter end of January, or the 1st of February, while our spawning time is from the middle of September to the middle of March, the throng from the middle of November to the middle of December, and from appearance of the fish we are likely to have them earlier and later than

even that period,; for this year, during the fishing season, we took ashore three salmon clean spawned in August, and it is likely there were many more of the kind in the river at that time; and I have often seen unspawned salmon in the latter end of March; therefore, I am safe to say, that the spawning season, from first to last, is more than six months of the year. I am not certain, and have a very great doubt, of the ova being all ripe in one day; for I have extracted only a very small portion of ripe ova from a fish, and found it impossible to divest it of the remainder, it being still firm in the cadds. If the ova were all ripe in one day, and the milt only by degrees in the course of eight days, how should it happen that the one takes eight days to spawn as well as the other? I must therefore state here, for the information of those who may intend to breed artificially, that, if they shall force the whole ova from the fish at once, they may count on a very great deficiency of young fish at hatching time.*

* Although the greatest care be exercised towards the ova in the artificial breeding ponds, whether it proceeds from the unripe state of the ova or from imperfect impregnation, there is a great preponderance of loss in the artificial boxes over the seed deposited by the fish in the river. I found that to be the case throughout all my artificial experiments; and these having been performed merely as experiments, so as to arrive at facts in the natural habits of the salmon, and not for the purpose of increasing the numbers, all the events and results were watched with the most particular attention; and, on the whole, this loss was more, in my opinion, than would warrant the continuation of the process, depending on it for a very great increase to the natural produce of the river; however, a small addition is certainly better than none.

I find Mr. Tod Studdart, a gentleman who has had a deal of experience among salmon and salmon rivers, in writing on the natural resources of the Tay and tributaries, calculates the

The German trout also take a much shorter time to hatch than they do in this country. For Mr. Jacobi

number of fish that spawn there annually at 30,000; viz., 15,000 males and 15,000 females. He says:—"To each of these I assign an average weight of 10 lbs.; this being the usual average ascribed to a Tay fish. A ten-pound breeder, it has been ascertained, yields about 10,000 ova—certainly not fewer—consequently the number of ova cast in the spawning season on the various breeding grounds referred to may be computed at 150,000,000. How much of this large amount of spawn are we entitled to suppose is brought to life, becomes distributed over the rearing ground, attains the smolt size, and, assuming its plumage, eventually finds its way to the sea or firth? The hazard to which these 150,000,000 pellets are subjected may be described as follows:—

First. In every *wain* there are what are known as the barren ova; in other words, there are pellets on which the effusion of the milt has no effect; these, however, in general form a very small fraction of the deposit, not more than a hundredth part; the detriment, in fact, accruing from this source is so trivial as scarcely to deserve notice.

Secondly. There is a surface loss—I mean by this the loss of that portion of the ova which escapes from the fish without being covered up—consequently it is carried onward by the current, and becomes the prey of trout, eels, water ouzels, &c. Under the same head may be included so much of the deposit as happens to be inefficiently ploughed in; and I may add, also, the contents of *redds* formed upon the side water or extreme shallows which are exposed to draughts before the hatching time. These casualties alone very seriously affect the ova, and reduce them, in all probability, to one third of the original amount. The insinuating quality attributed by eminent naturalists to the milt does not permit me to affirm that any one pellet on the natural bed escapes contact with the inoculating fluid; I therefore abstain from concluding that the deposit is in any respect damaged for want of the material requisite to preserve or vitilate it.

A third casualty to which the spawn becomes exposed takes place immediately on their being hatched, or while the process of hatching, which occupies several days, is going on; then it is during the consumption of the vitelline bag, that the common trout commits its most serious depredations, being in a hungry

tells us that three weeks after the spawn was sprinkled into the troughs, the eyes of the young fish

state, and unprovided as yet with either ground or surface food. Allowing that 50,000,000 of the ova had actually been brought to life, the injury done at this stage by kelts, trout, pike, sea gulls, and waterfowl, cannot be estimated at less than one half the number as already noticed. During the after continuance of the fry in the river and its tributaries up to the time of their descent as smolts, seeing that new elements of devastation are brought into play, such as the weapon of the angler, the pout-net of the poacher, the mill-wheel, droughts, disease, &c., it is fair to set down the further injury resulting from these causes at 5,000,000 more, so that the 150,000,000 that I have assumed, upon premises by no means unreasonable, that are annually shed over the breeding grounds of the Tay, 20,000,000 of smolts may therefore be considered as the annual offspring of this river and its tributaries.

I now proceed to contrast with the results just arrived at, those which are likely to accrue from the experiments in artificial spawning by Mr. Ramsbottom at Stormontfield. The number of ova which the boxes for hatching are intended to receive (they are now, I understand, implemented, and the contents under process of being hatched) amounts to 400,000. How many of these pellets, allowing every proper caution to be taken with respect to them, are likely to be brought to life? This is a question of considerable importance, and can best be answered by reference to the results of some former experiments in pisciculture.

The one reported by Mr. Halliday, as carried on and brought so far to completion, in connection with the salmon fisheries at Outeranch in Galway, throws some light upon the question. This experiment was conducted, I understand, by Mr. Ramsbottom, on the same system as that pursued by him at Stormontfield. Mr. Halliday, in regard to it, admits the deposit of 40,000 ova, one third of which he is under the impression has been rendered useless during the hatching process; and now the remainder have been committed to the rearing ground, which, at Outeranch, I am led to believe, consists, instead of artificial ponds, of a natural sheet of water. He seems convinced that as they are approaching the smolt stage, they are undergoing a still further reduction in point of numbers; in short, that the available yield of 40,000 ova consists at present of about half that number of fry.

appeared in the egg; and that in five weeks they had bored their heads out through the shell.

We may here notice what Mr. John Shaw, of Drumlanrig, says of his experimenting on the trout of the Nith, one of the tributaries of the Solway.

"On the 1st of November, 1839, having discovered a pair of sea-trout engaged in depositing their spawn in the gravel of one of the small tributaries of the Nith, and being unprovided at the moment with the necessary apparatus for their capture, I had recourse to shooting, as the only mode within my power of insuring instant possession of them. However, the vigilance exercised by both parents in protecting the ova from being devoured by multitudes of smaller fishes which surrounded them, rendered it exceedingly difficult to seize the precise moment at which both might be disabled by one discharge of the piece. This, however, was at length effected, by shooting immediately across the heads of the pair, as they lay parallel to each other, but more by influence of concussion than the actual effects of the shot, they being at the time in about six inches deep of water. Having taken them ashore, I proceeded to spawn them by pressing the ova of the female into a little water by the side of the stream, and afterwards by the same process I caused the milt from the body of the male

Applying Mr. H.'s impression as to the loss sustained during the hatching process to the Tay experiment (and Mr. H. is evidently a sanguine advocate in favour of artificial breeding), I feel at liberty to deduct one-third from the 400,000 ova committed to the Stormontfield boxes as a portion of the deposit likely, during the process of hatching, to prove worthless.

If the providing for the fry on their being hatched in artificial ponds and reservoirs, and a supply of food administered by the hand can so be termed, I view this stage of the experiment with considerable apprehension.

to mingle with it. I then removed the impregnated ova, in a copper-wire gauze bag, in which some fine gravel had been placed, to a little stream connected with my experimental ponds. The temperature of the water was at this time 47°, but during the winter it ranged a few degrees lower. By the fortieth day after impregnation the embryo fish was visible to the naked eye, and on the 14th January, 1840, *seventy-five* days after impregnation, the fish were excluded from the egg."

There is here a very great difference in the time of hatching. Mr. Jacobi's trout were hatched in *thirty-five* days, and Mr. Shaw's took *seventy-five.* At the time Mr. Jacobi tried his experiments, perhaps a hundred years ago, his views might have been right, but I have not a shadow of doubt in the correctness of Mr. Shaw's statements, and I only make these observations to show artificial breeders that they need not be disappointed although they have the ova 140 days unhatched in place of thirty-five.

We have also accounts of artificial breeding of fishes in China, but these accounts are so imperfect, that from these we can gather no information that can be useful in the present time. It is said they gather the seed in large tubes or vessels in some of the large rivers in China, and sell it to merchants, who carry it into the provinces, where they sell it to those who have rivers and ponds which they wish to re-stock; and that the ancient Romans also bred fish by procuring the ova, and sowing in the rivers as we sow corn. I have no confidence to place in either of these accounts, and I would advise all artificial breeders to be of the same mind; for these statements are so ridiculous, that it is only those who have not the most distant idea of the habits of salmon, that will believe one jot of them. Who could believe

that by damming up a river, the spawn of fishes could be gathered in tubs, and sold by measure? We are aware that sturgeons are fished on the Rhine and Danube for the sake of their spawn, but not for the purpose of sowing, but to make *isinglass* and *caviare*. And were the spawn of any fishes to be sown in a river as we sow corn, what purpose could it serve further than to feed the fishes and vermin frequenting that river?—for we are aware that spawn of all kinds is eagerly sought after for food by all fishes, and to sow it in the rivers by bushels, (however, the Chinese only say by measure, and that might have been very small, from the unlikely means of procuring it), it would have only been an extra feed to the fishes of that river. But if it was productive at one time, or at least expected to be so, how now, when China and the Roman States are in a much more advanced state of civilisation and intelligence, has that system of propagating fish been discontinued? I have frequently talked with gentlemen who have traversed the banks of the Hoang-ho and Kiang-kean, the two largest rivers in China, and I could never get any information regarding sowing the spawn. The truth is, that Hoang-ho dissolves so much clay, and the water is so impure, that it is unfit for the habitation of fish, with the exception of the coarsest kinds. We must therefore conclude that neither the Chinese nor Romans have given us any substantial information worth acting on; and indeed Mr. Jacobi, the German naturalist, has traced his artificial breeding very litle further than the egg; therefore, I will endeavour to give an account of the fry from the exclusion from the egg to the smolt state.

SALMON FRY.

When the young fish are confined in the shell of the egg, they lie in a circular form round the yolk, and they burst the shell by their many turnings to get straight; and the first opening in the shell generally takes place at the middle of the fish, or opposite the back fin, and, like unstringing a bow, the tail starts out at the rent, whereby the fish becomes straight, and nothing remains in the shell but the head and conical bag, which only remains covered for a short time, for the motion of the fish and the water now getting into the shell soon throws off this last encumbrance, and the fish appears free and at large in the pool. In the first moments of their existence in the water, we see their fear of danger visible, for from the least shadow or movement they seek shelter below the stones and gravel, and only return to the open water when all danger disappears.

On their exclusion from the egg they are generally about three-fourths of an inch long; some are even less than that, and a few among them are larger. The provision bag that is fixed to the belly is fully one-fourth of an inch, the head round and large for the body; and on the whole, at a little distance, they look more like a tadpole than a fish. A fringe of fin round the body, resembling the tail half of an eel, is all the fins that are discernible at this time. As the fish advances in size, the bag gradually decreases, and at the age of five weeks the bag is wholly consumed; and the fringe-looking fin that surrounded them from the back round to the central fins has also gradually worn away, and left the proper fins in their proper places. The fry now assume a more fish-like ap-

pearance. But now they have to encounter difficulties altogether foreign to them; the provision bag, from which they fed from the moment they began to exist, is now empty and gone; they must now work for their food, and search it among the water. But we find that numerous deaths take place at this time, very possibly from the change of living, and the food in the first instance not agreeing with them.

But the survivors seem very soon to get familiar with their new employment; and collecting food seems an amusement as well as necessity, for they run, leap, and sport, and catch greedily at the smallest object among the water. At this age they require to be regularly attended and fed.* Brown bread,

* When the conical bag is consumed, or nearly so, the hand-feeding should begin. This must not be done by throwing a quantity of food over the pond at once, the greater part of which would fall to the bottom and be lost; it must be widely sprinkled over the whole surface of the feeding-pond, so as the fry can catch it as it sinks to the bottom, and as soon as the particles are eaten up, more should be scattered over the pond so as to ensure their being all fed. This process must not be carelessly gone over, for on the attention and regularity at this time depends all the future success. And in a feeding-pond of the extent that would be required at Stormontfield, where they have some chance of hatching 200,000 fry, the regular feeding of which will afford the constant occupation of several persons; for during the first few weeks of feeding, they should be hourly supplied with a few grains each; and from a calculation to that effect, the feeders can easily judge the quantity to be given at each time. As the fry gets larger, the quantity of food must be augmented; this will be understood from the rapidity in which it is eaten up; and the regular feeders will soon come to understand when they have enough from their careless appearance; but they must in no case whatever discontinue the food while they appear eager to catch it: and unless the artificial breeder strictly observes all these things, he cannot expect the imprisoned fry to increase in size in proportion to those in the open river, neither can he expect them to arrive with regularity at the smolt state. I am aware that in

pounded small and sprinkled over the pond, is eagerly catched at. But the most greedily sought-after food that I tried was salmon roe preserved from the former year; and, being cured into a hard body it was easily pounded into the size of oatmeal; that they caught at in preference to everything else that was given them. Salmon roe can be got in abundance at any curing establishment during the months of July and August, and may be preserved for that purpose. In their after stages it will be found very convenient, as well as suitable, to hang carrion or any sort of birds on poles over the breeding ponds until they get fly-blown and full of maggots; these maggots fall into the ponds and are keenly devoured. During summer this is the most convenient way of feeding, for the carrion attracts numerous bands of flies of all sorts to the ponds, part of which fall among the water, which are speedily seized on.

At the age of two months we have the young fish fairly formed, head and fins complete and the transverse bars on the sides perfectly visible. The fry at this age is upwards of an inch long, some of them an inch and a half; they now feed well and are very active, seeming well pleased from the want of the encumbersome bag they were troubled with; they are now fairly started, and no sickness nor death appear in the colony; all seem ready for breakfast at the earliest hour. At the age of four months they are

artificial breeding the incubation is the most simple part of the process, and that the whole difficulty, risk, and, I may add, expense, occurs after incubation is completed; however, by strict care and attention, I hope that those whose good intentions have led them into the artificial process will not find it altogether a failure, although it is certain that it will land far under the anticipated mark.

about two inches long and getting far more familiar, hundreds of them running to catch any particle of food thrown into the pond. At the age of six months they are about three inches long and thick in proportion, but still the fins large for the size of the fish, and the transverse bars very dark; they now leap about, and appear well satisfied with both meat and lodgings. From six to ten months their growth is very slow; the low temperature of the water during winter, and also the scanty supply of food during that time, operate sadly against it, for at the age of ten months we find scarcely any of them longer than three and a half inches. But they now appear more soft in the colour than they do during winter; they are more light-like, and the transverse bars not so dark and visible as they were previous to this time, for between the ages of two and nine months these bars appear very dark. At the age of eleven months they have quite a different look; the silver coating now has begun to make its appearance, and the bars look less visible; as the scales have begun to cover them, we now see as if looking through a clear glass; and, on the whole, during the last month they have very much approached to the smolt state. They now, during the twelfth month, change wonderfully, for at the end of it—viz., one year from the time they were excluded from the egg—we find them completely enveloped in their silver-looking coat, and the cross bars have altogether disappeared; but at this time they are so tender, and these small scales so loose, that the least thing will rub off the scales as well as injure the fish; they are not at all of that hardiness that we find a small trout under the smolt size that is got in nearly all rivers, about which there has been such an amount of speculation and argument. This trout when full grown is about the size of a salmon

fry of nine months old. Last year, in August, I furnished to Doctor Knox a specimen of that small trout, along with salmon smolts from the river that month. And the whole misunderstanding on that head arose from the times that no interval was allowed between hatching and the smolt state; for the cleverest of naturalists, as well as those who observed by the river side, always thought that the fry that were hatched in the spring were the smolts and grilses of that summer. And neither Mr. Jacobi nor any other of these early naturalists or experimenters gave the least information on any of the habits or sizes of the fish at their different ages. All that they told was only, if the ova and the milt of the fish were mixed together and placed in a running stream of water, similar to the stream that the fish placed these ingredients in, that these seeds would produce young fishes; they either did not know, or, at least, forgot to tell, what came of the fry until they arrived at the smolt state, or what their age was at that time. I have no doubt but these early artificial breeders remained satisfied that the spring smolt was the produce of the last winter's eggs, and such was the universal belief. At that time, as yet, the whole year's crop of fry remained in the river a year, as they did and do so still, and was seen during summer by every one near the rivers, but was never suspected to be salmon fry, and of course the whole of these young fish were named "par," meaning a state of equality, or a small or full grown fish. But when it was discovered, by artificial breeding and feeding them up in confinement, that the fry of the salmon remained a whole year in the fresh water after being hatched, and that the smolt seen going down in the course of spring and summer were the fry of a previous year, then it was seen that a great number

of what was formerly called "par" was the young of the salmon; and those familiar with the salmon fry in all its stages from the egg to the smolt, could easily distinguish them from the other young and old small species of fish that frequent all salmon rivers in one particular: the young of the salmon in all their stages has fins large in proportion to the body, whereas the other small full-grown fishes of their size have fins in proportion, and look altogether like an old fish, and these may be got in rivers not frequented by salmon, and above falls where no salmon ever penetrate. This altogether is the misunderstanding about the par and fry. One part asserts that the small fish still in the rivers, and resembling the young salmon, have a right to retain the name of par, as the others, at last, were found out to be what was not suspected. With this part I am much inclined to agree, and to allow the young of the salmon to retain the name of fry and smolts, as acknowledged by all and sundry of our Scottish acts; for if one prosecuted for their destruction under any of these acts, we find the act as a precedent; but if we proceed in a court of law, under the name of "par," I am doubtful of the result if the case were opposed. The other part asserts that the "par" is the young of the salmon; this is also true, that the young of the salmon were supposed par, but, in talking of the fry, they say the "par" of the salmon, which, according to all former established titles, is an unmeaning name. However, now what is meant by "the par of the salmon" is understood by all parties; and for simple purposes it signifies but little whether the young of the salmon get the new or the old name; perhaps the new one is the most fashionable, if we could get it incorporated into the act for their preservation.

As soon as the smolts fully assume their migratory

dress they entirely change their habits, for they gather in bands, leap and sport through the pond, feed greedily, and search round every corner of the pond either for more food or for an outlet, or more likely for both, for it seems that at this age their hunger increases, and they partake more of the gluttonous nature that produces their rapid growth in the sea, where only they can get that desire fully satisfied, and where they arrive at perfection. At the real smolt state, such as we see in rivers as well as in artificial ponds, their size varies from and between four and six inches, but the great majority are about five inches; those above and below that are merely exceptions. When they get into the river in this hungry state, and are convinced that those bred in the river are the same, they go in bands like locusts, and devour up every thing in the shape of flies, worms, and insects; from this nature arises the fearful destruction of them by rods and flies, crooked pins and worms, or whatever can be offered to them in the shape of food; and also at mills where it has been a practice from time immemorial to fix creels at the bye spout of the trough, and in the morning the creel was found full to the brim of the smolt that had come down the lead. This is a system of poaching that, with the exception of a few rivers, has been entirely neglected, although it be among the very worst kinds of it. When the smolts get down past all these traps and into the open river they gather together in bands, and may be seen for many yards as close as herrings; but in a calm evening, a time when they scatter over the river in search of food, they are seen leaping as thick as a hail shower, which shows the immense numbers that are then in the river, and going down. The greatest throng of them is in April and May, corresponding with the greatest throng of

spawning in November and December; a high or a low temperature of the water during winter has the effect of a corresponding difference in their assuming the silver coating and leaving the river. Notwithstanding the great throng going down in these months, they are to be seen much later and earlier, and few or more of them going down throughout the course of six months, and likely longer; for according to the length of the spawning season must be the length of the season that the smolts are going down. It was fully the belief at one time that the whole crop of fry in the rivers became smolts at the same time in spring, and all left the river with the first May flood. But that would never do now; for we have many times no flood at all in May, therefore we would have of course no smolts going down. To be sure a moderate spate at times is favourable, for it relieves them from pools in small streams and rivulets where they are confined, but otherwise those that reach the open river will go at their season, whether they get a spate or not, and they do so, for they are often seen on their passage when rivers are in low summer ply.

I marked a number of smolts on their way to the sea, and continued this process for several summers, but yearly changed the mark from one part of the fish to another. This marking was done particularly for the purpose of ascertaining the exact time that the smolt was absent from the river until it returned a grilse; because it was the opinion of some, and some even assert it yet, that smolts are a whole year in the sea before their return; but if they were a year they must be more—they must have been *fourteen months*. However, without marking them at all, we are certain that salmon in no stage of their migrations remain that time absent from the rivers. What I marked was in April and May, and in course of June and

July following we caught several of them with the same marks, grilses varying from three to eight pounds, but did not catch in the following year a grilse with the smolt mark of the previous year. And although I continued marking and searching for them on their return, the result was invariably the same. And from these experiments and the length of time the marked smolts were absent, I am of the decided opinion that the great majority of them remain away only about two months.

The first of the grilses generally appear in the rivers in May, although I have frequently seen a few of them in April, and in 1852 we caught a grilse in March, and that year several of them were got during that month in the north. When the first of them appear they are small, varying from one to three pounds. This small size has been erroneously attributed to their short stay in the sea; but it is nothing of the kind, for these small grilses we get in May went down smolts in March, when the temperature of the water was exceedingly low; and although that low temperature had not the power to change their nature, yet it had the effect of stinting their growth, for in size they are long and lean-looking to what they are afterwards. As the temperature of the water advances, so does the fish, and by the middle of July, if the summer be good and warm, we have grilses at their best size. In a cold, spitting, and rainy season we never have fine full grilses, and I often hear from those who have been long among them, "the grilses are small this year," but they never look out for the cause of that deficiency. I am aware that the nature of the fish has not changed, and that they have lost none of their rapacity and power of digestion, but they have lost that one thing whereby they improve in look and size.

Yes, they want a bright sun and warm water, and that alone gives us heavy, well-shaped, and fine-looking fish. We often see in the month of August that grilses in general are less than they are in July, but that entirely depends on the season, for if August be warm and dry, the grilses are fine and large, but if cold and wet the case is quite the contrary.

When grilses leave the sea for the rivers, they generally do so in bands, the same as they do when going down smolts, and it is likely they continue in company of each other throughout their feeding season; and when we see a number of them going up together, we invariably find that they have a leader, for one of the largest is sure to be first and all the others follow in the tract; and often we find, although not always, that an old salmon or two lead the way to a number of grilses, and that their travel onward is regular and steady, and, unless when frightened by something or other, we never see one pass another in their march, for every thing is regular, and in the most trained-like order. They would continue in these regular bands on to their river, were it not that they are, time after time, scattered by their natural enemies in firths and estuaries; these enemies watch their progress on, and feed on them as they pass, and scatter the remainder to and fro throughout the waters, and as these enemies generally haunt the deep waters, the grilses run on the shallow sides, where these monsters, from their size, have not the ability to follow them. But when they are forced to run on the shallows and near the land sides to avoid these monsters of the deep, where is the advantage? — for they are just leaping out of the frying-pan into the fire; the band is running different ways to escape from a seal or some such enemy, but while doing so they all land among the meshes of some vile invention

placed there by man, their very worst and inveterate enemy. That and many other siclike of all shapes and contrivances they have to encounter between the sea and their native river; and it is very few indeed that reach there, for between the sea and it the caterpillar have devoured what the cankerworm left. The few grilses that are fortunate enough to reach the river spawn the same year along with the salmon; in general they are the first who occupy the breeding banks, and we see them there in pairs as regular as the salmon are; but we also see that a female salmon has no objection to work along with a male grilse in the event of her not being fortunate enough to find one of her own age and size. The ova of a grilse of five pounds weight is about one-fourth of a salmon of twenty pounds, for they spawn a *thousand* ova for each pound they weigh,—that is, a salmon of twenty pounds will spawn twenty thousand grains of seed, and a grilse of five pounds will spawn five thousand grains. The ova of grilses, according to their number, are equal to those of salmon, both in regard of time in hatching and also in producing as good fry, for we find them hatch in the same time, and the fry continue equally large in all their stages. There must be the same difference in the quantity of the milt of the grilse and salmon as there is in the ova; therefore, whether the milt of a grilse be sufficient to impregnate the whole ova of a female salmon is a question yet to be solved; at all events we find that the milt of a male is all exhausted during the time that the female is laying the eggs: this happens to both salmon and grilses, and therefore, as we are aware that nature has formed nothing in vain, we must conclude that the whole quantity of milt in the one is necessary for the whole ova in the other, and in that case we are led to believe that when a

female salmon works with a male grilse the impregnation must be to that proportion deficient. We see several accounts to the contrary of this ; for we see it stated that the milt of one male is sufficient to impregnate the ova of several hundreds of females, but saying is not doing, and before we place implicit confidence in such statements we require a proof positive, and I fear that those who work according to that theory will find an awful deficiency at counting-out time.

I will now conclude this account of the habits of the salmon with a few practical observations on the necessary management and preservation of rivers. In the first place, as I have already stated, the first and greatest object to be obtained, is to give the fish the full and natural close time provided for them by nature ; give them the seed-time and harvest suitable to their circumstances, and not by ill-considered enactments try to force their summer into winter*,

* The later in the season that we continue our open or fishing season, to the same extent we drive back the spawning time into the winter, and also to the same extent we curtail or reduce our early salmon fishings. Since adding three weeks to the latter end of the fishing season, the early rivers have gradually become worse and worse, until now they have arrived at a state scarcely worth fishing. The Tweed Act allows the net to be used regularly on to the 15th of October, being one month later than the other rivers in Scotland. Being the border river, although one of the best in the kingdom, or rather in the two kingdoms, for it is half Scotch and half English, it has been always unfortunate; for the Scots poached the one side, and the English poached the other. Its close and open time always varied from other well regulated rivers, and yet the Tweed laws are radically wrong from top to bottom. They are so much so that they have turned that famous river, whose natural capabilities are unrivalled by any river in Europe, into a mere fishery of bulltrouts and grilses, and the spawning season is driven back to February and March, when

and their winter into summer, and thereby destroy all probability of their existence: nature knows that

the fish, only ascending to spawn at that time, are caught by the nets and destroyed. Mr. Thomas Todd Studdart, who has, perhaps, the best capabilities (of seeing and judging of the abuses and wants of that river) of any one on Tweed side, lately, in a communication on that subject to the editor of the "Kelso Mail," says: —

"The opening of Tweed on the 15th of February, as is well known, has of late years been signalised, or rather rendered notorious, by an immense slaughter at many of the netting stations, not only of kelts (spawned fish), bnt of baggits and kippers to boot (male and female unspawned salmon). Last year, as I have been given to understand, scores of ripe spawners were captured, during the opening week, below Tweed Mill; and in the vicinity of Twizel I have known to the amount of eighty she-fish, all large and primed with *ova*, having been taken in a single day from the Tweed on a similar occasion, and there is every reason to believe that the termination of the present fence-time will be followed up, as usual, by extensive massacres of unspawned salmon and grilses. Now, what I propose is this: that the proprietors or parties holding salmon fishings on Tweed shall instruct competent persons to attend the various netting stations, at the opening of the season, for the purpose of expressing, collecting, and inoculating, when opportunity offers, this unusual wastage of spawn, for the purpose also (not of stowing it away in wooden boxes, over which an artificial run of water shall be directed), but of committing it to "redds" formed with the shovel, hoe, or plough, in the bed of the river itself, there to await, as a matter of common certainty, its being brought to life.

"In Tweed there are at hand fifty fords where such redds might be scooped out side by side, if thought expedient, at almost no expense, and the roe deposited in them without the loss of a single pellet. A little below Tillmouth, for instance, also opposite Lees and Edenmouth, there are fine gravelly stretches, secure from drought or the effects of large floods, where this experiment might be ventured on; but preferable to these, in my estimation, are certain portions of the river situated betwixt Melrose and Kelso, such as the Monk's ford above Dryburgh, and the lower portion of Mertoun Water, near Little Dean Tower.

suitable time better than we can do, and if we try to force them to produce their young against the laws of

"My preference for an upper range of the river is formed upon an acquaintance with the instinct of the salmon, owing to which, in their choice of spawning-ground, they are generally guided to a considerable distance from the sea; and seeing that the motives which sway them cannot be traced to any regard to their own personal security, I am led to conclude that such instincts are connected entirely with the security of their spawn or offspring; however, I don't insist upon this as a matter of such consequence, and it is possible enough that the experiment I suggest may after all prove as successful in the neighbourhood Coldstream as in that of Newtown or Inverleithen. In comparing the advantages which the proposed mode of cultivating the salmon stock possesses over any system of artificial breeding hitherto attempted, very little need be said. These advantages declare themselves. They are as manifest as daylight. The experiment, properly conducted, cannot fail. It is at once the simplest, the cheapest, and the most certain mode of propagating salmon that can possibly be adopted.

"Immediately on the expiry of close time, the nets and cables are set in motion. A few shots determine, in most cases, the contents of the river, near the stations where these are made. For every clean salmon taken on Tweed during the first fortnight, there are at least a dozen of kelts, and four or five unspawned fish generally in a very forward or mature state. These are secured, as a matter of course, during the ordinary endeavours made by the fisherman to bring the net into contact with something better; there is no cost or extra labour therefore required in order to obtain the spawn, farther than the attendance of one or two men at each station to collect the ova and conduct the inoculating process, and deposit it in the 'redd.' Can anything be simpler or less expensive? Well, mark the results. There is a quantity of ova which never would have a chance of being brought to life, these ova, down to single pellets, are rescued from certain destruction, and buried, with extreme care, in a certain portion of the river, where no ordinary calamity can possibly overtake them. The result will be that almost all the ova inhumed will come to life. And say that they form the supply from only two hundred baggits, each baggit yielding a trifle beyond 10,000 ova, we have at once added to the natural resources of the river a hatch or

nature, we are certain in the end to produce an extermination of the race, as we have already nearly accomplished. From all the observations I have made, the best, the most natural, and the most productive close-time we can give them is from the middle of the August month to the first of January.

Secondly.—When the laws are changed to reason, and an abundance of breeding fish in the river, and even at a suitable time, we require to keep a strict protection over them, to protect them from their worst enemy *man*, who are not content only with killing them when clean and in a state fit for food, but who will follow them to the spawning-bed, and leister them off the shallows when in the very act of depositing their seed, and when they are unfit for the use of man: however, the rapacity for their destruction, notwithstanding a perfect knowledge of their effecting a serious injury, does not prevent their destructive propensity, and nothing, under the present inefficient laws, but a strict and an expensive establishment of police can prevent their utter destruction; and although the laws were altered, and made sufficient for the improvement of rivers, such an

brood consisting of 2,000,000 of fry, all vitalised at the expense of a few pounds sterling. Of these fry nearly one half, without any additional cost whatsoever, is likely to attain the smolt size; and allowing that only a single individual out of two hundred finds its way back to Tweed in the shape of a grilse, the annual produce of the river undergoes an increase of nearly 5,000 available fish."

[I certainly agree with Mr. T. T. S.'s plan of collecting and depositing the ova on Tweed. Since the stupidity of the act does not, and will not, allow the fish to deposit the seed themselves, and also permits the slaughter of these fish without reserve, something of that sort is essentially necessary, and the plan proposed would at least secure the ripe part of the seed, and at very little expense.—Ed.]

establishment, to a certain extent, would still be necessary.

Thirdly.—It is essentially necessary to destroy as many of vermin as possible, which prey and feed on both the seed and fry. The first of these, which is a close attendant on the spawning bed, is the water ouzel. They watch the beds with the cunning of a fox, and when the fish fall back in their regular working turn, they dart into the hole in search of any seed that may remain uncovered, which they never fail to pick up and carry off, but as soon as the fish approach the bed, they escape to the nearest stone, where they remain watching the next opportunity of another picking. This they continue day after day during the whole spawning season; and during that time one ouzel will devour an immense quantity of ova. But these are enemies, although destructive, that with attention are easily got rid of; for as they are neither shy nor easily frightened, they may be shot close to the beds without any difficulty. I have got the river-watchers to kill them at sixpence the head, until they are nearly killed off in the North. It is also necessary to kill cormorants, cranes, gulls, and all such like birds, which are awfully destructive to the fry and smolts, for they prowl about small streams and river mouths, and particularly in pools left by the tide, and actually feed on the fry both small and large.

Lastly.—I may mention the common river trout. Of them we have various kinds, all of which are most determined enemies to the ova, fry, and smolt of the salmon. First, they watch the spawning operations the whole time that process is going on, and their own spawning season being over, or nearly so, before the salmon begins, they are there hungry and ravenous, ready to devour the ova as soon as it is

dropped; and from a certain attraction that the ova has, the trout are led to the very hole where the ova is lying: they are often prevented and fail in their attempts, for the fish seem to be always on the alert for them; but yet they often succeed, and when they get within sight or reach of an ovum, they will be seen darting at it with the agility they do at a fly, run off with it, and soon return again to the same spot to watch the next opportunity, and only leave it reluctantly when driven away by the salmon. This we see over all the spawning fords, the salmon eager to come up and protect their seed, and the trout as keen and eager to devour it. I have caught numbers of these trout during the spawning time, but never found one of them but what was full of the ova; some, when opened, had upwards of fourscore of grains, and the whole of them had less or more; therefore, in course of the whole season, the destruction of ova must be immense. And yet their destruction does not stop here, for as soon as the ova is all covered up, they attack the fry in the river, and continue to feed on them until they leave for the sea. As an experiment, I at one time put into a pond along with a trout of half a pound weight a dozen of very fine smolts of fully five inches long, at the time they were leaving the rivers. This was done in the evening, and when I examined the pond next morning, the trout had eaten up the whole dozen, and might perhaps have doubled that quantity: however, seeing what was done, I did not feel inclined to try afterwards what the exact number that could be eaten in one night might be, for what was done was a specimen of the destruction done in a salmon river in the course of a year, and be an inducement to destroy as many of them as possible. But owing to their prolific nature, we cannot expect to get en-

tirely clear of them, for they breed in burns and small rivulets, where they are seldom disturbed; and although numbers of their fry may be eaten up in lochs and pools by the larger species, yet immense numbers of them escape and arrive at maturity. To be sure, large quantities of them could be caught with nets made for the purpose, for at the latter end of the breeding season they congregate in the deep pools, from whence they could be dragged with the net, and by repeating that process weekly or oftener, a great many of them could be got out of the river.

I would also as much as possible encourage otters in a salmon river, where, from destroying such quantities of trout, it will be found most useful and of the greatest benefit. The otter has been long misrepresented, and counted among the enemies of the salmon, but when the whole case is rightly considered, in truth it is one of their best friends. The otter has undoubtedly been known at rare times to catch and kill a salmon, but these are rare times indeed, for he will never attempt the unlikely game of salmon while trout can be got in the river, or even eels in their season. When frosts shut up the lochs and also the pools of the river, the otter may catch a salmon by pouncing upon it in some open stream, but that is the only time we find one killed by it. The otter fishes for sport often when food is not required, and when he falls in with a well-stocked pool, he leaves dozens of trout on the bank unbroken, which he never returns to eat; for when the river is open there is no difficulty of procuring plenty more, and at a cheap rate. And on the whole, when all circumstances are taken into consideration, in place of the otter being ranked among the salmon enemies, we must give him the

credit of being placed the very first of their four-footed benefactors.

We have now endeavoured to state the past and present state of our salmon rivers; what they were under good laws, and what they are under bad ones; how they were formerly cared for, and how now they are neglected; also the spawning, hatching, rearing, migrations, and growth: and hope that all these things will be taken into due consideration and acted on, and that some one more capable than I am will supply the deficiencies which inability has omitted.

APPENDIX.

Salmon Spawning.

Letters in Bell's Life, 1850.

"Mr. Editor,—The first appearance of spawning this season was on the 17th September. Two pairs were seen that day busy at work; and as the river was low, they were distinctly seen digging out the gravel from the bed, or rather making a hole, wherein to deposit their seed. They were not scraping it out, after the alleged fashion of some observers, with their tail, but quite the contrary; they were boring their snouts in among the gravel, till sand and mud were rising to the surface of the water. I here mention pairs, because salmon all pair distinctly at the spawning time. They are never seen in a mixed mass, as many imagine them to be, at breeding-time; neither are two female fish seen with one male on a spawning ford, although a small male is often seen with a large female, and *vice versâ*, when necessity requires it. Salmon never spawn in deep pools or still water, although they invariably fall back to such places to rest from the labours of the spawning field; and when they are seen in these pools by a careless observer, he at once pronounces them to be spawning there; and without any more consideration or study, counts and tells the number he sees (whether odds or evens, it signifies nothing). From such careless observers proceed the imaginary, unnatural, and impossible assertion, that salmon dig with the tail and spawn promiscuously."

From Mr. G. Boccius.

"Mr. EDITOR,—I have read, with considerable interest, the letter of 'A. Y.' in your last Number, on the cause of the scarcity of grilse, this past season, in the Northern rivers. But the scarcity has not been confined to the North only, as every river in the United Kingdom has met with a similar fate. Your experienced correspondent has most correctly hit upon the true cause of the deficiency of fish, and I can only hope that his indefatigable perseverance will press him to more minute observation; namely, he states, and with truth, that the floods of 1849 have been the cause of the serious falling off of salmon stocks; and he further believes that the whole of the hills (spawning-beds) were washed away.* This, I think, is an error, for if 'A. Y.' would be good enough to examine the hills in the month of April, should the rivers have run thick and flooded this coming spawning season, I have every reason to state that he will find the eggs addled, instead of being washed away. The cause of the eggs becoming addled is very simple; agricultural pursuits † are extending with great rapidity through the whole empire, whether it be in the valley or on the hill; and consequently, as every brook is the sewer to the surrounding district, so does the water become turgid upon the fall of rain; and should such be the case during the process of incubation of the

* "A. Y." said nothing of the sort. He did not use the word "whole" at all.

† "Mr. Boccius seems to be thinking of nothing else but the rivers of the well cultivated and manufacturing districts of England. He is evidently little acquainted with the great salmon rivers in the north, and their feeders, or he would never compare a mountain burn to a sewer. 'A. Y.' will laugh at his notion of alluvial deposits, addling of the ova deposited in salmon spawning beds, and will tell Mr. B. why so. Natural obstructions are not, generally speaking, the cause of the decrease of salmon, but artificial ones, such as bag-nets, stake-nets, and other poaching devices. The propagation of salmon by 'artificial spawning,' will be of little avail as long as the present annihilating salmon fishery laws exist. I am glad that the question of salmon is every day becoming a more public one, and I shall next month write one or two essays on the subject.—Signed 'Ephemera.'"

egg of the salmon, then the pedicle or neck of the same is stopped up with alluvial deposit, which hinders the necessary proportion of oxygen of the water from penetrating the embryo, and consequently suffocation ensues; the egg becomes fœtid and very injurious to the water, so that the stock in such water must moreover become sickly. Some three years back, when a noble and generous Duke gave his fisheries a jubilee, for the purpose, as was thought, of restoring his salmonries for the benefit of the public, by producing a larger proportion of food, I wrote to him that such would be of no avail; and such has proved to be the case, upon the authority of the letter of 'A. Y.' And as much of all our fisheries in the United Kingdom must go back from the wild and natural state, so it becomes our duty to look to the artificial production of them in the same manner as breeding other animals for the wants and use of man. I therefore trust, that as the habits of fish are becoming equally known with the habits of other animals of agrarian worth, landed proprietors will give this subject an undivided attention; for when it is considered that one million of salmon brood will produce ten million of pounds weight in two years, I ask, then, what can produce a larger increase than water, when properly attended to?"

From Bell's Life.

"Mr. Editor,—I see a letter from 'Mr. Boccius,' on the 'Scarcity of Salmon' last season, which so far agrees with the letter of 'A. Y.' in the same number, regarding the effects of the floods on the spawning fish, although he seems to think that the quality of the water had more tendency to the evil than the quantity of it had: I would therefore beg to say that Mr. B. is entirely mistaken when he believes that the turgid state of the water, or alluvial deposits, are injurious to the breeding of salmon. In the first place, salmon select for their spawning-beds the shallows, where the river, at its lowest state, runs sharply over the gravel bottom, and where no alluvial substance can lodge; and when the river is flooded, all such combinations of matter are deposited in deep still pools and

eddies, where they can find a resting-place, and where it is well known that salmon never spawn. In artificial spawning we may find the ova addled from the effects of alluvial gatherings over the place where we have deposited the seed; but that is entirely owing to our having selected a wrong spot in the river—a place where the stream never had the required velocity. But in natural spawning there has never occurred any thing of the kind, for nature has taught the fish the exact spots wherein to deposit their seed; and in these selected spots seldom or ever has their labour been found in vain, for when once the seed is fairly covered up, nothing injures it, unless the *banks, beds, and all,* be carried away by some flood or similar accident, which often happens when a flood overtakes late breeders with their beds half finished. In the second place, natural breeding must, in all cases, be preferable to artificial breeding, for in the former a right selection of the necessary spot is made, when in the latter, were the process to become general, I fear that, in many cases, very unsuitable spots would be selected. And how could we expect it otherwise, when we see naturalists (?) of the present age tell us that salmon spawn in pools? Allowing artificial breeding to become general, by what process could the seed be advantageously secured? We are aware that it is useless to take salmon, for that purpose, from any place but off the spawning beds; and even then we have only an eighth or a tenth part of the ova in that ripe state that will ensure production. Therefore, by extracting such a quantity of useless seed from the fish, it would undoubtedly be making bad worse. Artificial breeding is a practicable process, whereby we can stock fishless and barren rivers, and make them productive: but in no other case would I prefer artificial to natural spawning. Only give us natural laws for the right management and protection of the salmon, and *with these* no natural cause can prevent the salmon from increasing to the *ratio* of the fifteenth century."

Scraps from Ephemera's "Homilies."

"For several weeks past, an interesting and valuable controversial correspondence has been carried on in the open-armed old *Bell*, touching the scarcity of salmon last year in particular, and touching its scarcity in general for some years back. The question is assuming so much public importance, that *The Times* has just taken it up, and I am glad to perceive in a right spirit. Something on the subject is expected to be said by me. The scarcity of salmon last year, at any rate, of grilse, or salmon in their second year, is easily accounted for. The cause, there can be no doubt of it, was the bad breeding season of 1847-8, produced by floods that destroyed the ova, and sometimes the fry. Let us see why floods should destroy ova and fry. Salmon spawn from September to March, but the exact time at which they principally do so is from the middle of November to the latter end of the following month. They invariably deposit their ova in shallows, technically termed 'fords,' and never, under any circumstances, in deep water; never in quietly running pools, or in lochs or lakes. Now, if when the fish are depositing their ova, or about to deposit them, floods should occur, several circumstances destructive to the ova will follow: the ova will be washed away and destroyed, and the fords will be rendered deep, and the fish driven to seek for shallows on the banks inundated, where they will deposit their ova; and when the flood subsides, the ova will be left high and dry on the banks, or on the sand and gravel shore above the usual water mark. These are two of the destructive results of floods during what is called the 'throng spawning period.' We will now suppose the spawn deposited and the seed covered in; one would suppose the ova safe from spates or inundations. They would be so, and the mere torrents would sweep harmlessly over them; but unhappily they frequently sweep away with them weirs and embankments; and these, as they are carried along, carry with them the bottoms of fords and shallows, and so destroy wholesale spawning beds in which the ova has been deposited. If floods of

the latter description happen at any period during the incubation of the ova, or soon after they have been incubated, great injury must be the result: less, certainly, to the fry fully developed than to the fry in ova, or to the fry merely a *fish fœtus*. Besides all these casualties, floods disturb the spawning salmon in divers other ways that I think cannot be positively pointed out: I certainly dare not attempt to do so.

"Salmon fry remain in their native rivers one whole year, at the end of which they migrate to the sea in search of food. A month after incubation, the embryo salmon assumes a perfect, or nearly a perfect, fish form, with transverse bar marks on the sides faintly developed. These marks go on increasing until the fish are eight months old, when they are fully developed, and a row of beautiful pink spots are now observable along the lateral line; in truth, the salmon fry is now as beautiful a little fish as one would wish to see. It resembles much a little trout called the 'par,' but is not the 'par,' as, I am sorry to say, many think it is. In Ireland, when at this stage, it is called the 'graveling;' and as it now takes the artificial fly very eagerly, they are killed in great numbers. How to prevent this calamity I cannot tell. It is also destroyed by other means, and something should be done to protect salmon in their fry state. After the age of nine months the transverse bar marks rapidly and visibly diminish; and at the age of twelve months they are ostensibly gone, and the fry, now called a smolt, assumes a silvery hue on the sides, in fact, almost the colour of an adult salmon in prime condition. The silvery colour may be called its migratory coat, for directly it assumes it, provided its natal river has the requisite quantity of water to carry the young wanderer easily over weirs, &c., it migrates to the sea, where, on selected feeding ground, it remains generally between two and three months, sometimes more and sometimes less. It then returns to the river of its birth a grilse, may be of three pounds', may be of ten pounds' weight; say, on an average, if it be the descendant of a salmon of large breed, of six pounds' weight. This, so far, is the history of fish; so that ova deposited early in December, (the time of incubation averages, according to

my calculation, one hundred and twenty days,) will be incubated early in the following April; and in the April twelve months, the fry will be smolts, and in two or three months after grilse of goodly size.

"I have now to account for the general scarcity of salmon during some years past. It is called scarcity in contradistinction to former abundance. My task is easy and short. I have but to say one or two words—*defective legislation* —they comprehend all the causes of salmon scarcity—stakenets, bag-nets, weir traps, cruives, leistering, a miscalculated close time, and, of necessity, a wrong close time. I should like to know how many Members in both Houses of Parliament understand the history and habits of salmon. Fifty? I doubt it. I should like to be mistaken, but I fear I am not. How can you legislate for that of which you know nothing? How can you confute the assertions of the monopolists,—of Lord Monteagle, for instance,—if you know nothing accurately of the history and habits of the valuable creature you wish to preserve? You possess some information, but the major part of it is erroneous, and therefore you are as badly placed for the purposes of correct and wise legislation, as if you were in outer darkness. You must totally do away with stake and bag nets; at any rate, when fixed within arms of the sea or in rivers, for they are the alpha and omega of abominations. And you must begin your close time, as a general rule, by the middle of August; open it as early as you like for clean fish: make kilt killing fineable, and leistering spawning fish doubly so; do these things, and there will be no longer a scarcity of salmon."

The Decline of the Salmon Fisheries.

From the Scotch Reformers' Gazette.

"We think it is high time that the public attention should be seriously called to this subject. We hope it will be taken up by the new ministry, and here we are willing to admit that protection is imperatively required. We pointed out in a recent article the true cause of the rapid decline of the fisheries. The salmon are simply

over-taken; and unless the number of nets is diminished, we have every reason to believe that they will soon become entirely extinct. With our coasts, at the mouths of rivers, completely surrounded by a great tissue of network, how is it possible for any fish that breeds in these rivers to survive or multiply as formerly? Really there is no mystery in the matter. It is simply the case of the hen that laid the golden egg. For upwards of twenty years that bag-nets have been in existence, every engine of destruction has been brought to bear against the salmon, and still there are people who profess to wonder that it does not continue to be taken in as great numbers as formerly.

"The remedy for this evil is completely in the hands of the government. There is no difficulty about it; the evil exists because there are thousands at present using bag-nets, &c., who have no right to do so. Let the Crown enforce its prerogative, let all these illegal nets be swept away for several years at least, and then let only a reasonable number be authorised, and we do not hesitate to say, that the salmon will re-appear in as great numbers as ever. Let every assumed proprietor of a fishing be called upon to produce his title; and is it not fair and reasonable to ask that those who cannot do so should at least desist immediately. Some people think they ought to be required to disgorge the amount of their illegitimate profits during the last twenty years; but we would be satisfied with simply prohibiting them in future until they acquired by purchase, grant, or otherwise a proper title. This is a step on which the public have a right to insist. We are astonished at the general apathy on this subject. A great and general outcry was raised against the Corn Laws, because it was alleged that, for the sake of a certain class, the price of food was raised to the great mass of consumers. So long, however, as the Corn Laws existed, the landlords were entitled to the prices produced by those laws. But here we have a certain article of food raised to famine prices by the cupidity of men who have really no legal title to what they are accustomed to claim as their exclusive property. What is this but a species of wholesale robbery? In former times, salmon was a staple article of food in this country. When

the fishings were less numerous, and limited to the rivers, the fish were so abundant in the land, that it formed an article of general consumption among domestic servants. It is even on record that in some places convenient to fishing stations, they protested against being kept on it too exclusively. So different is the case now, that even with persons of comfortable means the salmon is but a rare luxury. It finds its way only to the tables of the well conditioned and affluent. Let it be universally understood, that this arises from over fishing by persons who have no more right to do so than thousands in this city who never so much as taste salmon. We think, therefore, that some public movement should really be made in this matter. The influence to contend against is great. Vested interests, if not vested rights, are deeply involved in the question; but if a determined movement were made, we have no doubt that justice would ultimately triumph, and that with the fishings placed under proper restrictions, the salmon would soon become so abundant as to form an important article in the general consumption. Once let the fish begin to multiply faster than they are taken, and no one can prescribe a limit to the numbers which they will soon attain. It is difficult and dangerous to interfere with private rights; but where there are really no rights, or none that are not derived from the Crown, there is no difficulty in the case. A single year of jubilee might do wonders, and this might be universally enforced as preliminary to placing the whole system under proper regulations.

"In the approaching general election, which cannot be far distant, we hope the constituencies throughout the country will make this a capital point, in electing their future representatives. Let them be all pledged, if need be, to protect the salmon. Let them be at least pledged to see justice done in this matter. We hold it to be a point of great importance, as involving the abundance or scarcity of what was once a material article of food. It may seem ridiculous to attach so much importance to it now in the present dearth of fish, but who is to thank for that dearth? We hold this to be the very circumstance that calls for a general, immediate, and united movement on the subject.

"In the mean time we conclude by calling attention to the following letter from a correspondent, who seems to be thoroughly conversant with the subject, and whose remarks therefore are well deserving of attention; he thinks the close season commences much too late, and we are disposed to agree with him. The great source of destruction, however, is, in our opinion, the excessive multiplication of unauthorised fisheries along the coast.

"'*To the Editor of the Reformers' Gazette.*

"'Sir, — In the Gazette of the 14th inst., I see an article on the fast-decaying state of "Salmon Fishings in Scotland." And indeed the falling off in the numbers of that valuable fish is truly alarming to all who are concerned in any way with salmon fishings. The decrease has been gradual for the last twenty-three years, and the decaying state of the fisheries during that time has been as often represented to the proprietors of these fisheries; but as long as rents could be got with even a small decrease all applications for alteration in the manner and management of the fisheries were in vain. The article in the "Gazette" is quite sound with regard to bag-nets and fixtures, and even had they not reduced the general quantity of salmon, they could only be viewed in the light of a permitted robbery. For when the Crown granted a charter of salmon fishing to proprietors on rivers, it was not the intention of the grantor that another party would be allowed to raise up barriers on all the main runs of the fish, and there intercept them on their way to these rivers. I hold that the Crown, to whom all salmon fishings belong, would be breaking faith with the parties to whom they granted the fishings of rivers, were they even to do what they have allowed others to do all around our coasts. When Crown grants of fishings were given, that was done under very wise restrictions, and these with a view to the general good; for salmon in those days was no inconsiderable part of the food of the country, and it was the intention of government to continue it so. The individuals to whom these grants were made, were prohibited

from erecting weirs, bulwarks, cairns, or any device whatever, that would obstruct the ingress or egress of salmon to and from the rivers. Nets of less than two inches and a half on each side of the square of the mesh were illegal, as under that size they were supposed to kill the young fish. They were also bound to protect the red and black fish during the close time, so that by strict attention to these regulations, the food of the country would not be found diminishing; and when these rules were strictly attended to, salmon were abundant in all the rivers and streams in the kingdom; and under the same regulations, I have no hesitation in saying we would have them so still: but I have little faith in the frequent-attempted salmon legislations; for even these attempts, although they were successful, are of such a puny nature, that they would only give a drop in the bucket of what is required. And until government put a stop to these coast-side marauders altogether, any attempt at just legislation on the subject will be entirely out of the question; for it is sure to be opposed by them and their supporters, and is almost sure to undergo the same fate as the bill introduced by the Duke of Argyll last year. What we require in the first place is a regular close time, and that at the proper season for salmon throughout their breeding time. No salmon should be caught after the 15th of August in any year; for it is well known that from the 15th of August to the 15th of September is the proper time for the breeders running up the river, and that very few go up after that time. Therefore, we may fully conclude, that the present fishery laws could not be more properly fixed for the destruction of salmon, although they were intended to end the race. The rivers at present are strictly preserved during the present close time; but that can be of little benefit, as breeding fish are now rarely to be seen, and never can be seen while these everlasting barriers are allowed to stand round the coast from the 1st of February to the 14th of September. But just clear off from the coasts and estuaries all fixed machinery, and close the fishings on the 15th of August, and in the course of a very few years hence, Scotland will have salmon both abundant and cheap.'"

The Time of Plenty.

From Scotus to Bell's Life.

"Mr. Editor,

"Before the very interesting discussion in your pages on the salmon question closes, an account of the largest draught of salmon that was ever taken in Great Britain, or probably in the world, may be deemed worthy of insertion. The river Thurso has been for some time the scene of remarkable sport with the rod as detailed in your broad-sheet; but the following extract from the first volume, page 31, of 'The Life of the late Sir John Sinclair, Bart., of Ulbster, in the County of Caithness,' will rather astonish your readers. "In the 'Statistical Account of Scotland,' chap. ii. sect. 1., mention was made of the celebrated draught of salmon in the river Thurso, when no less a number than two thousand five hundred and sixty were caught. With the view of having the fact ascertained, the following certificate was given by three persons who witnessed the transaction, and are of unquestionable veracity.

"'We, George Paterson (now bailie of Thurso, chief magistrate of Thurso, which is a burgh of Barony), George Swanson (shoemaker there), and Donald Finlayson senior (flesher there), do hereby certify and declare, that upon the 22nd day of July, old style, we think in the year 1743 or 1744, there were caught at one haul, on the cruives' pool, upon the water above the town of Thurso, 2500. These fish were caught by a large net, beginning the sweep at the cruives and coming down the river to a stern at the low end of the pool; the net was carried down the water by eighteen or twenty men, with long poles in their hands, keeping down the ground rope, and the fish were afterwards taken ashore by degrees in a smaller net. We further certify and declare that we were personally present when these fish were caught.

(Signed) George Paterson.
George Swanson.
Donald Finlayson.'".

Scraps from the Rev. Dugald Williamson's Pamphlet.

"Salmon migrate twice in the course of the year, and the instinct which propels them from the sea in summer propels them to the sea in spring. Let the vernal direction of the propensity be opposed, let a salmon be seized as it descends and confined in a fresh-water pond or lake, and what is its fate? Before preparing to quit the river it had suffered severely in strength, bulk, and general health, and imprisoned in an atmosphere which had become unwholesome, it soon begins to languish, and in the course of the season expires; the experiment has been tried, and the result is well known. This being an ascertained and unquestionable fact, is it a violent or unfair inference that a similar result obtains in the case of those salmon that are forced back, from whatever cause, to the sea; that the salt-water element is as fatal to the pregnant fish of autumn as the fresh water element is to the spent fish in spring; that, returning to an abode which their instinct had taught them to abhor and prompted them to fly from, they soon experience the bad effects of the anti-natural compulsion; that if sexual cohabitation takes place at all, it is joyless and barren; that the languor and exhaustion which, under the most favourable circumstances, follow the great efforts of nature, become immeasurably more oppressive by exile; and that all these unfortunates are sooner or later destroyed, either by disease or by the voracity of their neighbours. If there is any truth in these conjectures, they suggest the most powerful reasons for *resisting* or *removing* obstructions in the estuary of a river."

Extracts from Ephemera's Homilies.

"A fish that is bred in a river, and breeds in it, and passes about three-fourths of its existence in it, must be considered a river fish. Its migration to sea is no more a proof that it is a sea fish than the woodcock's migration to Africa from Northern Europe is a proof that that bird is a native of Egypt, Algeria, or Morocco; it simply shows that the salmon is a migratory fish. Not only do

salmon never spawn in sea-water, but they never spawn in deep, whether salt, brackish, lake, or river water; they spawn invariably in shallow running water, in those parts of rivers of such depth, current, and exposure as will admit of a certain degree of oxygenisation from sun or atmosphere, without which salmon ova will not be vivified. Impregnated salmon ova have been repeatedly placed in the sand and gravel of the depths of rivers, and have been in every instance non-productive; portions of the same impregnated ova have been embedded in the running shallows of the same river, and have been invariably productive more or less according to season casualties favourable or unfavourable. What I have stated is the result of the observations and experiments of many persons; much of what I am about to say has been seen by thousands, and all is proven by observation, experiment, and the most direct and conclusive inductive reasoning and inference. The male and female salmon appear together on that part of a shallow in which their bed is to be dug, and they remain moving about upon it for a few days before they begin the process of nidification; no precise period can be fixed for such appearance. Salmon spawning beds are made by the fish in some sandy or gravelly part of the river, generally high up towards its source, and not unfrequently in rivers, and almost rivulets, tributaries to some larger river, itself tributary to the sea. Before two salmon, male and female, commence the formation of their nests, they make efforts to drive away every fish within their immediate vicinity. The spawning season extends over a period of six continuous months; on an average it begins about the middle of September, and ends about the middle of the following March. I may here remark that very few fish spawn so early as in September, and still fewer so late as in March. If the spawning season lasts, more or less, for six months, we must have salmon fry of various sizes and smolts in the river all the year round. The reader will find the following correct: The first fish that appear on the spawning beds are grilses, or young salmon of the previous year's incubation, and they are generally the precursors of mature salmon, that is, of fish in their third year and upwards. From the middle

of September, when grilses and salmon are first observed upon the shallows or spawning localities, they increase daily in number up to the first of December; the process of spawning is at its height from the middle of November to the middle of December. From the first of December to the middle of the following March, the number of salmon on the spawning beds diminishes in about the same proportion as it has increased from the middle of September to the first of December. At the end of March scarcely a pair of salmon can be seen performing the functions of procreation.

"I will now illustrate a very interesting fact in the history of salmon; it is important and useful also in enabling us to determine the growth of salmon. If salmon did not return from the sea to their natal rivers, the result of marking them when descending to the sea, and capturing them when ascending rivers from it, could not be easily ascertained, and we could not with general accuracy compute their growth between the time of their descent and ascent, between the time of their emigration to the sea and their immigration from it to fresh water. I hardly know anything connected with natural history of greater interest than is contained in the following passage: 'Before salmon commence the preparation of their beds I think, if not impeded, they will not stop in ascending rivers from the sea, until they have arrived at the spot, or at least very near the spot, at which they themselves first received life. This opinion I am able to illustrate by what appears to me exceedingly interesting and conclusive facts. Lochshin, a fine piece of water about twenty-one miles by four, situate in the heart of the Sutherlandshire mountains, is the immediate feeder of the River Shin, noted for its salmon productiveness. The loch itself has four feeders, middling rivers, viz., the Terry, Fiack, Garvee, and Currie, in which, previously to the year 1836, not a salmon was ever seen, though many were in the habit of entering the loch or lake. In the year mentioned, at the request of his Grace of Sutherland and Mr. Loch, M. P., salmon, male and female, were caught in the River Shin, shortly before the spawning season, and conveyed to the four rivers above named, amongst which they were dis-

tributed in due proportion. In the wonted season, all the fish spawned, each in its respective river. Now mark one of the consequences of this experiment. Salmon at present and ever since come regularly to spawn, traversing the lake to do so, in all these heretofore salmonless rivers. Nay more, the fish hatched in the Terry — at least those who survive long enough — return to the Terry, and the produce of the other three rivers return to them; each grilse or salmon enters never failingly the stream that gave it birth. What wonderful and unerring instinct! One would think that they would remain in the River Shin, and spawn where their first ancestors had spawned: but no; leaving their own natal shallows, they pass down the lake, through the River Shin, along the Kyle of Sutherland to the sea; and then having become adolescent, they retrace their route, and after necessary rests on their long voyage, very frequently on the spots of their fathers' nativity, they revisit for the first time the scenes of their birth and infancy. Revisit them for what? Being nubile to perform the nuptial rites which they do where their forefathers begot them, and so they go on increasing and multiplying in colonies heretofore tenantless of salmon, even ever since volcanic action called from the 'vasty deep the mountains and rivers of Northern Caledonia.'

"I shall now conclude this paper with a description of the immediate spawning operations of the salmon. The spawning bed, which may be called a continuation of nests, is never fashioned transversely or across the water's current, but straightly against it. The way the bed is formed has never before been accurately described. Some have affirmed the male fish to be the sole architect; others that the female does all the constructive work; others again, that the *tail* is the only delving implement employed; and others write that the bed-trenches are dug across the stream. These people — they must pardon my telling them so — are feather-bed naturalists. I have already shown the direction of the beds; it corresponds with the run of the river. A salmon bed is constructed thus: The fish having paired and chosen the ground for bed-making, and being ready to lie in, then drop down the stream a little, and then returning with velocity towards the spot

selected, they dart their snouts into the gravel, burrowing with them into it; this burrowing, assisted by the power of the fins, is performed with great force, and the water's current aiding, the upper part or roof of the excavation is removed; the burrowing process is continued until a first nest is dug sufficiently capacious for a first deposition of ova; then the female enters this first hollowed link of the bed, and deposits therein the first mature portion of her ova. That done, she retires a little down stream, and the male instantly takes her place, and pouring by emission a certain quantity of the milt over the deposited ova impregnates them. After this, the fish commence a second excavation immediately above the first, and in a straight line with it; in excavating, they relieve each other. When one of the fish gets tired of the work, it drops down stream until it is refreshed, and then with renewed powers resumes its labours, relieving at the same time its partner who had relieved it. Their labour progresses by alternate relief and exertion. The second bed completed, the female enters it as at first, again depositing a portion of the ova, and drops a little down stream; the male forthwith enters the excavation and impregnates the ova in it. The ova in the first part of the bed is covered by the sand and gravel dug from the second part being chiefly carried into it by the action of the current. The excavating process just described is continued until the female has no more ova to deposit. The last deposition of ova and milt is covered in by the action of the fish and water, and breaking down of some of the gravel bank above and over the nest. Thus is formed a complete spawning bed, not at once, not by a single effort, but piecemeal and at several intervals of greater or less duration, according to the age and size of the fish, and quantity of ova and milt to be deposited. A female salmon in its third year has a larger quantity of ova than a female grilse or young salmon in its second year; and it may be taken for granted that the older and larger the fish, male or female, the greater is the quantity of ova to be deposited and milt to be emitted. In consequence, the time occupied in deposition depends upon the size and fecundity of the female fish. The average time is from five

to ten days; it would be more exact to say the mean time lies betwixt.

Extract from the late Sir Francis A. Mackenzie, Bart.

"In the autumn of 1840, having chosen a brook running rapidly into the river Ewe, a hollow spot adjoining to it was selected and cleared out, of the following dimensions: — Length, twenty-three yards; breadth, from twelve to eighteen feet; and all large stones having been taken away, the bottom was covered one foot thick with coarse sand and small gravel, the larger stones not exceeding the size of a walnut. A stream from the brook was then led into this hollow, so as to form a pool of about eighteen inches in depth at the upper, and three feet at the lower end, thus giving it one uniform gentle current over the whole pool; whilst the supply of water was so regulated by a *sluice*, as to have the same depth at all times, and a strong stone wall excluding all eels and trout, so destructive both to spawn and fry.

"On the 13th of November, four pairs of salmon, male and female, were taken by a net from the Ewe, and carefully placed in the pool. On the 18th they showed a disposition to spawn, but on the 20th, the whole was carried away by some ill disposed persons, and on examining the pool, only a small quantity of ova appeared to have been deposited. On the 23rd, four pairs of salmon were again taken and placed in the pool, which were observed to commence spawning on the following day. Caught them carefully, squeezed gently about 1200 ova from a female into a basin of water, and then pressed an equal quantity of milt from a male over them, stirred the two about well, but gently, with the fingers; after allowing them rest for an hour, the whole was deposited and spread in one of the wicker baskets recommended by Professor Agassiz, having about four inches of gravel below them, and two or three inches of gravel above. A similar quantity of ova, treated in the same way, was also deposited in one of the copper wire bags,

as used by Mr. Shaw, and both were then immediately placed under water in the pool. A little of the ova was buried in the open gravel about three inches deep in another basket, and also in a copper wire bag; two or three inches of gravel were laid over the bottom of each, and both basket and bag laid in the pool covered by four inches of water. The ova of a female and milt of a male were then successively squeezed from two fish on both the basket and bag, and spread over it regularly with the hand, one after the other, and after leaving them in this state exposed to the water for a few minutes, the whole was covered with two or three inches of gravel, and left in the pool. These four pair of fish afterwards emitted voluntarily a small quantity of spawn which had been left with them. And on the 1st of December they were all turned out into the river. On the 3rd of December caught three pair which had partially spawned in the river Ewe; used another basket, and also another wire bag, treating the spawn in the same manner as last described. These fish were then also allowed to deposit voluntarily the little spawn of which they had not been deprived, and afterwards turned out into the river. On the 19th of February, examined the ova, and life was plainly observed in the baskets, wire bags, and unprotected gravel; both were placed artificially, and were deposited by the salmon themselves.

"19th March. The fry had increased in size, and went on gradually increasing, much in proportion to the temperature of the water.

"22nd. The eyes were easily visible, and a few of the ova had burst, the young fry having a small, watery, bladder-like sac attached to the throat.

"18th April. The baskets and bags were all opened; the sacs had become detached from their throats. The fry measured about three quarters of an inch in length, and they swam about easily,' all marked distinctly *as* 'par.' The baskets recommended by Professor Agassiz proved superior to the wire bags of Mr. Shaw. In the latter, only about *twenty per cent.* came to maturity, whilst in the former not above *ten per cent.* proved barren, and in the baskets used the 5th of December, not *five per cent.* proved barren. It is impossible to say exactly the pro-

portion of ova that came to life, either of that artificially impregnated or deposited in the open gravel, or of what was spawned by the fish naturally. But as far as could be judged, they succeeded equally well with that in the baskets. Perhaps the baskets may have a preference over the other methods tried, as affording more certain protection to the spawn during winter. And it is proper to state that the last-described mode of depositing the ova and milt was most successful. There can be no doubt, from the success that has attended these experiments that the breeding of salmon and other fish in large quantities is, comparatively speaking, easy; and that *millions* may be produced, protected from every danger, and turned out into their proper element at the proper age, which Mr. Shaw has proved, by repeated experiments on a small scale, to be when they have attained about two years of age. When the par marks disappear, they assume the silvery scales of their parents, and distinctly show a strong inclination to escape from confinement, and proceed downwards to the sea.

"Professor Agassiz asserts, that the ova of all fish, when properly impregnated, can be conveyed in water of a proper temperature even across the Atlantic as safely, as if it were naturally deposited by the parent fish, so that any quantity of salmon or other spawn, can, after impregnation on the banks of a river, be carried *to* other streams, however distant, which may be favourable for hatching. It may be right to observe, that as the fry are to remain two years in the artificial ponds when hatched, fresh places must be used every second year for the spawn, as even one-year-old fry will destroy spawn, or their more infantile brethren if left together. Old spent salmon are also destructive to both spawn and fry."

Salmon Legislation.

From Bell's Life, March, 1853.

"Our legislators have again met for a season, and great things are expected from such a combination of talent and experience; some parties want one thing, and some want another; and undoubtedly a great many

grievances require to be redressed, and numerous existing evils require to be rooted out altogether; but among the various classes who have a right to complain, none have a greater than salmon fishers, and all connected with salmon property. I particularly allude to Scotland, although convinced that England and Ireland are not in a better condition. However, ever since the present Fishery Act for Scotland came into force in the year 1828, the salmon fishings of Scotland have been on the decline. In all the history of fishings, we meet with seasons better and worse than others, and may always expect to do so; for in *part*, the prosperity depends on the fluctuation of seasons, but even with all these uncertainties and natural causes, we would not, and could not have had a general and gradual decline in the fisheries, if the natural habits of the salmon had been unfettered and freed from the unjust and unsuitable Acts of Parliament whereby they are trammelled, and the fish *forced* to decline. We might yet have a season or two not so productive as previous years, but we could never have reached the brink of extermination on which we stand just now; for it is a plain matter of fact, that no salmon river now, even the very best, is worth one-fourth of the value it possessed thirty years ago, and very many of them that were productive at that time must remain henceforth tenantless, as now they will not pay the outlay for watching and working them. Thirty years ago you might have gone over the length and breadth of the land, and on the whole not found a salmon river without a tenant, and all tenants thriving on the produce; but now you will find two-thirds of the fisheries in the hands of proprietors, and no wise man will take a compliment of them. What has become of all the respectable companies and firms that occupied the Scotch fisheries thirty years ago? We may here say that they are gone. They fought honestly and honourably against absurd legislation, until they were forced to fall in the conflict, and their loss may now be mourned all over the fishery world. But yet with all these facts staring our legislators in the face, and I assure you they are far from being exaggerated, they have looked on with the greatest apathy for many years, though quite sensible

that a great and valuable part of mercantile property was fast disappearing from the country, it appears. But they say that it is dangerous to speak from appearances. However, it appears that the principal study of government for years past has been, whether Toryism or Whigism, or any other ism, will get the roast to rule, simply to do so, neglecting national property so much, that it has in a great degree suffered; but now, since the nation has had the fortune, I hope the good fortune, to get nearly all the conflicting ingredients rolled together in one lump, I really trust, which is also the aspiration of many others, that we will get the public business managed in a much more workmanlike manner, and what is done will be rightly done, or not attempted; for anything done in the shape of redress to the ruined salmon fisheries need not be attempted by any party who is not fully prepared to grapple with the evil in all its roots and branches, and more particularly the whole roots, as from them proceeds the greatest destruction. In the first place, an alteration in the present open and close time is essentially necessary. From the days of King Robert the First of Scotland, up to the year 1828, the salmon fisheries in Scotland opened on the 10th of December, and closed on the 26th of August. The salmon fisheries then were part and parcel of the properties of the Crown, and regulations to prevent over-fishing, to prevent illegal-sized nets and cruives, and to prevent poaching of all kinds, were strictly attended to. The lord lieutenants and sheriffs of counties were particularly instructed by the Crown to warn, to watch, and see if all these regulations were strictly attended to. And from this care of the different governments, and the strict attention of their officers, the salmon fisheries throve, and salmon increased in all the rivers to almost incredible numbers. Why should it not be the case still? The fish has changed none of its habits, and the rivers are the same. Summers and winters as variable as they have ever been, and losses during the spawning times may occur as they have done of yore, but these losses never brought an actual scarcity as we have now; for the truth is, that now we have scarcely a ghost of breeding fish, and I will tell you plainly, that neither with natural breeding

nor artificial breeding, will we ever have anything like a supply of breeding fish until the present fishery laws are changed; but let our fisheries open on the 1st of January, and close on the 20th of August, and very soon we will have plenty of breeding fish; for the whole dependence for such a supply is from early closing, and it is well known, that the clean salmon that ascend the rivers in January do not spawn until they again return to the sea; before spawning time, therefore, killing such cannot in the least injure the breed in the river. I would also allow angling up to the 1st of October, so as to encourage anglers to assist in protecting the breeding fish after that time. But I entirely protest against legalising rod-fishing throughout the year, as is now proposed by some, for it is evident that all salmon are getting foul and inferior after 1st of October, and very many of them long before that time. Therefore, to make it lawful to kill foul fish at *any time* of the year would be a large step in the wrong direction. And moreover, it would loose all the idlers of the country on the rivers, and why not? for what is sauce for the goose would just be sauce for the gander. If a gentleman kill a foul fish for sport, a hungry poor man will do the same from necessity, if there be no law against it. Consequently, we must condemn fishing of all kinds throughout the year in salmon rivers and streams.

"Secondly, the next thing the legislature has to grapple with is fixtures; viz. stake-nets, bag-nets, cruives, and in short all kinds and descriptions of fixed machinery, that stand in the way of salmon progressing to the rivers. Those who are proprietors of salmon rivers, have them either by a grant from the Crown along with their lands, or by purchase. But whether the Crown gave or sold these fisheries to the forefathers of the present holders, it is evident they were given for the salmon of these rivers, and not for the water of the rivers, and because they were a nursery for fish to be captured by others. Therefore, after these rivers and the salmon belonging to them were given away, it would be an entire breach of faith, were the Crown to erect batteries and bulwarks of any kind to prevent the salmon from reaching these rivers, and in that

case, if it would be unlawful in the Crown to do so, it is equally the same to allow any other person to seize on part of their property and use it illegally against the lawful holders of these rivers. I have, therefore, no hesitation in pronouncing all these erections illegal, destructive to the breed and prosperity of the salmon, hurtful to the rightful owners of these fish, and derogatory to the dignity of the Crown. If our present government shall allow any part of the Crown property to be seized on and used illegally, such may be done in some cases without a very patent knowledge of it; but in the case of unlawfully fixed engines, no such events can be pleaded, for it is a well known fact, that the injustice and destruction of these engines are seen over all the country, as plain as day-light. I therefore hope, whether it be the Duke of Argyll or Lord Palmerston (either of whom are very capable for the task), that we may have to rely on for redemption to the fisheries, we hope sincerely that they will guard against introducing any half-and-half measures, or making any compromise whereby any part of the evil will be allowed to remain under the shadow of law; for we shall never have anything like a healthy improvement of the fisheries, while one vestige of the destructive element remains.

"There has been great fatality in the introduction of Scotch Fishery Bills for the last twenty years. Most of those introduced were of such a trifling benefit to the fast-declining rivers, that the introducers got little or no support, and for my own part, I was always doubtful which of the parties had the greater benefit, the lawful or the unlawful party. I hope no such trifling will take place now, or ever again."

LETTER FROM ROBERT WALLACE, ESQ., OF KELLY,

To Inverness Courier, 12th September, 1848.

"I observe statements in your late number, showing the success which anglers for salmon have had in the Ness; and I rejoice to find that beautiful stream of right-coloured water for raising fish in, has afforded such excellent amusement to the numerous sportsmen whose names you have recorded as occupying that river at this late period of the

season. This feeling, however, on my part, is not without its alloy, for I know right well how destructively killing salmon so late in the season tells on the quantities of that matchless fish in future years. In saying this, however, I do not so much allude to the comparatively few which rod-fishers take, as to the havoc and devastation which is made over all Scotland among the breeding fish by bag-nets and stake-nets in the sea, and by cruives, and raft-nets, and other contrivances in the rivers, *during the last four weeks of the season as presently fixed.*

"I have long been sensible of the untold extent of the destruction of salmon inflicted under the present laws; and that this most mischievous loss of a highly valuable and nearly costless food has been immensely increased and aggravated by the use of the bag-nets and stake-nets now closely placed over all the coasts of the mainland and islands. The destruction formerly by the use of cruives and nets late in the year, was no doubt bad enough; but only a drop in the bucket as compared with the above inventions and appliances, which, literally speaking, now-a-days leave no part of the waters, whether fresh or salt, as a place of safety for the *early-breeding fish*, which all practical men admit to be the best and surest for multiplying the species.

"But as example is better than precept, and as I myself happen to be a rod-fisher, I will shortly exemplify the effects of the present law on early breeding salmon. I went yesterday to fish in the river Carron, which falls into the Dornoch frith, where the counties of Ross and Sutherland meet at Bonar Bridge. The banks showed evidently by the footmarks along them, that the river had been closely fished before my arrival, and left but little prospect of much sport; and it so happened that I had not a rise till past four o'clock, after which I raised four fish in very shallow water, slightly hooking two, and killing one of the others, a small female grilse of only five pounds weight, nearly one pound of which was of roe, already grown about the size of No. 2. shot; and this, be it remembered, in a small grilse, which many *self-complacent and very learned sportsmen insist are not breeders*, although all really practical men, whether fishers

or dealers in salmon, know quite well that grilses are even more early breeders than full-grown salmon. Well, the roe in my five pound grilse counted no fewer than 3782 grains, and to the extent of that number I have marred the chance of a similar quantity of smolts going to sea, and returning free of cost of any kind, as a most delicious fish to eat, and a capital size to angle.

"The mischief I happened to do on the Carron has been done, in a greater or less degree, by every successful angler over all Scotland, including of course those on the Ness, and especially the fortunate captor of its annual boast, 'the big fish.' Still, there is no blame to these sportsmen. The law sanctions the destruction now universally complained of, so that those who act under it must not be found fault with; but the *law itself,* and those who doggedly maintain it, must bear the blame; thus raising the question, Should such a law remain longer unrepealed?

"During the many years I was in Parliament, bills for the protection and increase of salmon in Scotland were unsuccessfully introduced in the House of Commons almost every session, until it became quite evident that selfish motives or gross ignorance, or both, prevailed so strongly that no rational alteration of the present destructive statutes could be obtained. For when we passed a wholesome change in the law through the House of Commons, it was certain of being either neglected or strangled in the House of Lords; and to that source is unquestionably attributable the maintenance of the existing most injurious statute. I believe that it is safe to say, that the proprietors of salmon fishings almost all over Scotland have long since plainly seen the mischievous effects of the law as altered by the present act, commonly called 'Home Drummond's Act.'

"Mr. Drummond, who is always open to conviction on every subject, long ago has seen the mischief most unintentionally effected by enlarging the open fishing season from the 26th of August to the 14th of September, and had he been allowed, he would have readily amended the evils attendant upon his own act. So much so was this his feeling, that after attempts had been in vain made to

reconcile interested parties to the curtailment of the present open season. He showed his desire to amend the law partially, rather than leave it in force all over the country; and I remember quite well his applying even to myself to lend my very humble assistance in having the River Tay and its tributaries placed under a local act, so as to revert to the olden time of closing in August, to do which I readily assented, although originally and for many years I was favourable to a general law, as provided by his (Mr. Home Drummond's Act); for under its provisions I had become perfectly satisfied, as I am more and more convinced, that a great deal of mischief has been inflicted on the public as consumers of salmon. It is my opinion, and always has been, that the laws that regulated salmon fishings were enacted much more for the benefit of the people at large as a body, than for that of those very few persons who are proprietors of salmon fishings; and, acting on this conviction, I have uniformly endeavoured to show to the magistrates and councillors of towns, that their constituents had a direct and deep interest in the laws that regulate the salmon fishings; because the abundance and consequent cheapness, or the contrary, of that most nutritious fish is a matter of manifest importance to the consumer.

"I say then fearlessly, virtually speaking, that salmon belong to the people, that their careful protection is a popular right, and consequently any undue destruction is a popular grievance; and if so, that these principles should guide the legislature and be acted on in Parliament, *in defiance of all selfish views and individual claims whatever.* So decidedly do I look on salmon as national property, that I consider it a duty encumbent on all magistrates to lend their best aid towards the alteration of the law, and to do all they can to increase the quantity for sale when sound and good, as well as to prevent foul fish finding their way into market in August and September. The markets of London, Leeds, and Manchester, are notoriously supplied with foul salmon in these months, which are easily known by the huge milts and roe they contain, and which none but foul fish have.

"No well-informed person will deny that salmon are

becoming scarcer every year. They are not to be found at all now in many rivers and streams they used to be bred and abound in. Machinery driven by water power is very generally blamed for this, but by whom? Why frequently by some of those greedy self-complacent or ignorant parties who own or who rent salmon fishings, and who, in these capacities, ply the calling of destruction or extermination, as the case may be, in the belief that their own pecuniary interests are of primary consideration.

"The above remarks chiefly apply to the taking of salmon in the open season, and to the ill-advised length of time allowed by law for this at present. But it never should be forgotten that vast quantities of salmon are destroyed in the night-time, in rivers during the breeding season, by means of torch-light. This most destructive and illegal practice is nearly universal, and, if I am rightly informed, it is on the increase everywhere. It is very difficult to detect, and equally so to bring offenders to justice under the present law, which, in my opinion, should be amended forthwith, as the period for killing salmon should also be altered.

"If it be true, as I aver, that the laws for regulating salmon fisheries have been passed, and are maintained, for the purpose of supplying the people with a most wholesome and nutritious food, to rear which literally costs next to nothing, then, I say, that it is for the interest of the people at large that the destroyers of breeding salmon in close time should be as stringently dealt with as the stealers of sheep, a crime also difficult of detection as well as of proof. And I see no better reason than prejudice and ignorance, and theftuous greed on the part of those who wink at or encourage the taking of salmon by using or purchasing it in close time, and more so as it then is a very unwholesome food.

"Many object to more stringent laws for the protection of salmon, chiefly because it is looked upon rather as private property than being confided to private individuals for the benefit of the public; and in this view the midnight robber of salmon is but too often looked upon as a very trivial offender, and as such is not unfrequently taken part with and leniently dealt by; whereas it would

be quite as rational to wink at or encourage the destruction of other kinds of food during its breeding season, such as cows when in calf, ewes when with lamb, and poultry when hatching. But the fact unfortunately is, that salmon are but too often looked upon merely as private property, forgetting all the while that the public are its consumers, and that its price in the market comes within the vulgar category of shillings and pence; and unless the care of it were entrusted to somebody, there very soon would be none at all.

"In conclusion, I may here say, that in so far as I have heard, the general opinion is that the open season for taking salmon should end on the 15th or 20th of August, allowing the time for commencing to continue as at present or to be made earlier by a fortnight; against such extension, I myself entertain a very strong objection.

"Having introduced two bills into the House of Commons for altering the present act, I may here state that one of these was to close the season on the 20th of August, and the other was to continue taking salmon with the rod until the 15th of September. When introducing these bills I distinctly stated my determination either to carry or relinquish both; for I found very many members favourable to the rod-fishing bill who objected to the one for shortening the season, and I would not be a party to the one without the other, and with this in view I first moved the curtailing bill, on which being beaten by a small majority I immediately withdrew the second, and so the affair ended. I am still favourable to the principle of both these bills, considering it of far more importance to the protection and increase of salmon when breeding to gain the good-will and support of proprietors of land in whose estates the breeding streams are, and where many fish would arrive and afford excellent sport between the 20th of August and the 15th of September, and in this way compensate in some measure for the very few that get there at present during the open season; and to this I may add, that the three weeks' extension of rod-fishing has worked wonders on the Tweed as a decided means of protecting breeding fish.

"I have only further to say, that I am not a proprietor

of salmon fishings, and that, *individually*, I would rather forego the three weeks' rod-fishing than thus obtain it at the expense of the injury it cannot but inflict, though trifling comparatively with bag-nets, stake-nets, cruives, and other nets, all killing fish in due numerical proportion, and containing their tens of thousands of embryo spawn, according to their size and age, as compared with my little grilse and its 3782 grains of it."

Extracts from Mr. Stoddart's Observations on Tweed.

"To look for the true remedy in the existing act and its amendment, is quite out of the question. A new measure conveying new powers, and adapted to encounter great exigencies, is required; to postpone or hesitate upon it is, on the part of the Tweed Commissioners, to condemn the salmon fishing to utter and irretrievable ruin; the working statute, which they flatter themselves by a stringent application to its clauses to render efficient, has, I repeat it finally, lost its virtue; to continue by it betrays a want of common sagacity, if not of common sense; nor will it do to attempt patching it up by a series of paltry amendments. From the base to the apex it has become unsound, and there is no course left but to determine its utter abandonment.

"In regard to the rental on Tweed, I find it stated in 1814, as 20,000*l.*; in 1823, as 10,000*l.*; while for the seven preceding years it averaged 12,000*l.*; it is now 5000*l.*

"With respect to its produce, the number of boxes of fish sent from Berwick-on-Tweed, in 1804 amounted to 13,000; in 1816 to 11,000; from 1818 to 1820, 8000, and in 1846, 3000.

"Enough I think has been quoted to satisfy any reasonable mind that the salmon fishings in Tweed have, for a long period, in common with those of Tay, Spey, and Ness, been on the decline. The reverses of 1851, added to those of the preceding year, are calculated to have a very disheartening effect. With the exact course of remedial agencies about to be applied by the commissioners I am not ac-

quainted. The substitution of a better-disciplined and more numerous river police for the protective force hitherto employed by them, has certainly the features of a restorative procedure; but, unassisted by other measures, I am far from being sanguine of its success.

"I have not yet made any remarks relative to the expediency of shifting the hibernal fence season in regard to Tweed: I am called upon, however, to do so by what was lately, and is possibly still in agitation among the upper proprietors, countenanced as their views happen to be by the author of the article in the 'Edinburgh Review,'—I mean the extension of the period of liberty enjoyed by the rod-fishers (a period which at present stretches from the 15th of February to the 8th of November), over the entire twelvemonth. Were no apology for this movement to be found in the conduct of the lower proprietors, I would farther without scruple affirm that the folly that looks forward to its success is only surpassed by the selfishness that dictates it. The extension required, and which in the main will favour the true sportsman, is that of the fence season during the vernal months; postpone the opening of the river above its estuary until the middle of March, and what is saved to Tweed in the way of giving opportunity for the largest description of salmon baggits to spawn and kelts to escape is beyond reckoning. I recollect well the occasion (it happened not more than seven or eight years ago), when old Rob Kerso of the Traws, at the opening of the fishing in the middle of February, captured with his net in the course of a single night no fewer than eighty salmon, almost all of which were baggits on the eve of spawning, unwholesome and useless as food, but as a breeding stock of very great importance. By means of the rod, constant and extensive massacres of these fish take place during the first four weeks of the season, and although a clean salmon is occasionally taken, the event is so rare that the local newspapers generally seize upon it as a matter worth recording.

"But those who would witness the salmon spearing of our degenerate day must not hope to find much food for the fine arts, or to wax sublimely poetical under the "cruzie;" the light and its reflections are all well enough,

and did no violence happen to the feelings from other sources, the effects of these upon wood, rock, and water in a calm night might be regarded with pleasure. All sensations, however, of this sort become disturbed when the massacre is at its height; fish swarthy or copper-coloured, gashed, gory and slimy, meet and disgust the eye; they look more like the proceeds of the Styx than of Tweed, more like reptiles, vile and unseemly both in hue and proportion, than salmon. To be forced to make a meal of such carrion, pinching poverty alone could do it; yet if spared and ocean washed, what prime bright nutritious fish all these at their next ascent into the river, if taken at a proper stage of the journey, would have turned out. This reflection alone heightens the feeling of revolt which their appearances have already engendered; but it is truly heightened, and becomes almost insufferable, when the eye is directed to the waste and utter destruction of that provision which nature has allotted to them for the purpose of propagation. The river has been despoiled in this one short night of a tithe of its treasures, of *thousands* upon *thousands* of those tiny pellets, upon the early deposition of which depended its future supplies of salmon. I am giving no exaggerated picture, I speak of occurrences that frequently happen; I allude to occasions, where from a single boat upwards of a hundred, ay, of three hundred breeding fish have been speared at one time, and to misname this the indulgence of a national sport, to describe it by milder terms than sheer profligate spiritless cruelty, is so to attempt colouring the fact as to pervert it into absolute fiction.

"This much for lawful poaching with the salmon spear on Tweed. The necessity that some measures, urgent and speedy, be taken to suppress it requires no farther demonstration. This error or misguidance, I designate it by an unwarrantably mild term, is the head and front of all the offending that has been committed against the spirit of laws protective, or meant to be so, of our Tweed fishings; and until it is put a stop to completely and finally, all hope of a restitution of matters to what they have been, or what they ought to be, may be thrown to the winds."

Food of Salmon.

"The salmon, as is well known, is furnished with strong jaws or mandibles, a mouth somewhat capacious and armed, as well as the tongue, with sharp teeth; it possesses moreover a broad gullet, capable of passing at one gulp no inconsiderable quantity of food. Provided with these powers and functions, it is at least reasonable to suppose that the inclination to use them is not withheld from their possessor. The fact, however, and it is certainly a singular one, that in few instances on record food of a corresponding description has been discovered in the stomach of the salmon proper, has led to the conviction on the part of several naturalists, that it subsists almost entirely on marine insects and ova, too minute for the naked eye to distinguish. To get rid of this difficulty it has been affirmed by some that the stomach of the fish acts upon the food absorbed with a rapidity resembling that of fire. Others again assert that the salmon is wont when in danger of being captured with net or rod to disgorge what it has swallowed, relieving itself by this process of whatever might help to impair its speed or paralyse its energies. I am not, however, I confess, disinclined to believe that a fish which engages discussion by the contradictory appearances it presents, namely, that of being furnished with voracious jaws and teeth, as well as an expansive gullet, while the stomach is almost on every occasion found void and inactive, must be possessed of extraordinary resources; nor am I altogether incredulous in respect to what has been related of the power of the digestive organs in some fishes, and the celerity with which these consume the food entrusted to them. I have in my possession two hooks, one an Irish tempered bait hook, taken from the inside of a small trout; the other a large double gorge hook extracted from the stomach of a pike; both of which present the appearance of their having been subjected to some powerful corrosion; the state of the smaller one along the shank has actually been reduced into a black substance, which betwixt the pressure of finger and thumb crumbles into powder, whereas the larger piece of wire

has been rendered completely attenuated, and is figured over with streaks or water lines, the entire hook having been exposed to the action of the stomach. With such proofs before me, I feel little hesitation in yielding to the opinion that the digestive organs of the salmon proper are of such power as to account in part for the seeming anomaly which the voracious character of its jaws and gullet, when contrasted with the void condition of the stomach, presents to the eye of the examiner.

From their immense power of digestion, and the abundance of food procurable in the sea, proceeds the rapid growth of salmon during their short absence from the rivers.

THE END.

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